

A Study on The Evaluation Process for Repair Costs of Work Trades of Apartment Buildings

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ABSTRACT

As construction industry climate changes rapidly and housing consumers expect higher quality, construction contractors are held more responsible and liable for defect maintenance and defect maintenance costs are rising steadily in response. However, it is true that construction contractors still relies on conventional and unsystematic approaches in planning and budgeting processes. As a result, planned defect maintenance costs by work trade based on conventional process vary from actual costs, resulting in significant opportunity costs as well. Therefore, it is necessary to study potential improvements to apartment defect maintenance cost estimation process.

This study is intended to improve apartment defect maintenance cost estimation process. Therefore, such systematic and efficient process improvement research is expected to improve effectiveness in apartment defect maintenance.

Keywords: Apartment, Defect maintenance cost, Process

1. INTRODUCTION

1.1 Background & Purpose

Due to rapid changes in construction climate, construction projects are now exposed to contradictory combinations of various and complex work trades, which results in numerous shortcomings and defects. Furthermore, as the ration between GDP vs. housing investment is maintained solidly within 4~5%, housing consumers expect higher quality and such expectation is spread extensively, construction contractors are held more responsible and liable for. However, as domestic market is still supplier-driven, housing consumer's expectation is not fully met yet. Accordingly, corresponding defect maintenance costs are rising steadily, undermining the financial integrity of construction contractors and

disputes over defects are severely constraining construction contractors's ability to address pubic grievances. Notably, it is not to be ignored that defects found after occupancy can impact not only current occupants and potential housing buyers as well and systematic approach must be explored to resolve such issue in the shortest time possible. As such phenomenon is found mostly in apartment shared by multiple occupants, this research is designed to limit the scope of research to apartment and focus on defect-prone building construction projects.

Researches on warranty bond and defect dispute have been implemented actively as in research on warranty bond-based defect prevention management (Hah, Hee-Yoon 2007) and analysis of types and issues of apartment defect disputes (Seo, Deok-Seok

2007), but, researches on improvement of defect maintenance cost estimation process to utilize and manage defect maintenance costs efficiently has not been conducted yet.

This research is intended to propose an improved estimation process for apartment defect maintenance costs in order to modify overestimated budget and plan, reduce opportunity costs and ensure efficient budget planning and execution thereby.

Accordingly, this research is expected to contribute to reasonable decision-making on budget planning and execution within construction management activities.

1.2 Research Process & Method

This research is focused on apartments accounting for most of housing construction projects as evidenced by statistical data of the National Statistics Office. This research is designed to examine defect maintenance costs budgeted and expended in apartment construction projects to such extent, investigate/analyze defect maintenance costs operated inefficiently by work trade and propose improved defect maintenance cost estimation process to resolve issues.

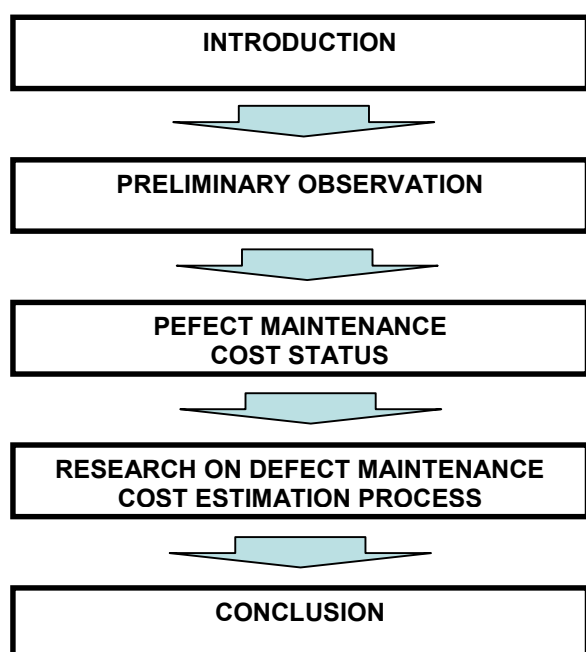


Figure 1:Research Flow

In terms of research flow, defects relating to maintenance costs are studied from theoretical/legal perspective and actual defect maintenance cost estimation process is analyzed and issues involving current defect maintenance cost estimation process are identified based on data furnished by Company S. Such data as available from Company S was reliable enough to pose no issues in generalizing conventional defect maintenance cost estimation process and this research is conducted to propose an improved defect maintenance cost estimation process by resolving such issues.

2. PRELIMINARY OBSERVATION

2.1 Analysis of Preceding Studies

Preceding studies focused on use of warranty bond as in the cases of 'Warranty bond-based defect prevention management' (Hah, Hee-Yoon 2007) and Warranty bond-based construction claim and dispute resolution process improvement approach' (Kim, Jong-Seo 2005) as well as on management of warranty bond as in the cases of 'Analysis of types and issues of apartment defect disputes' (Seo, Deok-Seok 2007) and 'Study of Systematic Defect Management Improvement Strategy over Apartment Lifecycle' (Park, Chang-Wook 2007).

Table 1:Trends of Preceding Studies

Author	Description	Observation
Hah, Hee-Yoon (2007)	Warranty bond-based defect prevention management ① Improve housing quality ② Ensure housing buyer's trust ③ Reduce disputes and proceedings	Preceding studies focused mostly on the use and management of warranty bond. However, there have been few researches to improve defect

Seo, Deok-Seok (2007)	Analysis of types and issues of apartment defect disputes ① Minimize legal proceedings relating to housing defects ② Present basic data for resolution approach	maintenance cost estimation process and address increase/decrease in opportunity costs arising out of over or under-budgeting of defect maintenance cost.
Park, Chang-Wook (2007)	Identify issues of defect management conducted on site ① Supplement existing defect breakdown structure ② Present approaches to ensure on-going defect management	
Kim, Jong-Seo (2005)	Project client's ability to resolve claim efficiently is a prerequisite for successful project delivery	

<Table 1> shows the trends of preceding studies. Significant amount of researches have been performed on the use and management of warranty bond while there have been few researches to improve defect maintenance cost estimation process and address increase/decrease in opportunity costs arising out of over or under-budgeting of defect maintenance cost, which results from the issues within defect maintenance cost estimation process and indicates the value of this research. Therefore, such issues of preceding studies are addressed herein.

2.2 Definition of Defect

Defect is defined by law as follows.

The Housing Act and the Enforcement Decree there of define defect as a 'flaw serious enough to damage function, aesthetics and safety of building or facility due to crack, droop, twisting, curling, settlement, breakage, collapse, leakage, malfunctioning, loose attachment,

grounding or wiring, poor line arising out of construction mistakes'¹⁾. In other words, defect means poor finishing or failure or breakage after completion in compliance with design drawing and construction specification. As such defects are found in all construction processes covering construction, material, design or maintenance, it is practically difficult to identify entity liable for defects and liabilities for defects are passed onto construction contractor simply on the excuse of difficulties in identifying liability for defect.

3. STATUS OF DEFECT MAINTENANCE COSTS

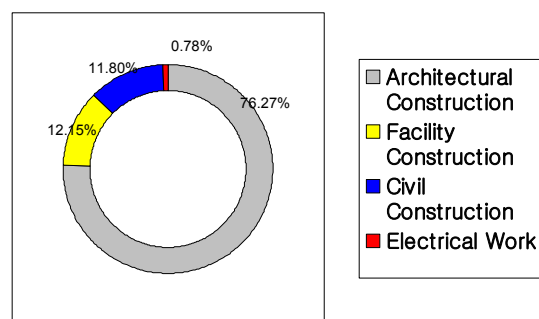


Figure 2: Defects Found in S Apartment by Work Trade between '04~'06

<Fig. 2> confirms that defect ratio of architectural construction is higher than other work trades (facility, civil, electrical work). The number of defects in architectural construction is 685,068 in total, much more than facility construction (109,133), civil construction (7,006) and electrical work (105,989), which indicates that architectural construction is vulnerable to defects.

Therefore, this research is significant in

1) Section 59 of the Enforcement Decree of the Housing Act 【Warranty by Project Client】 relating to Clause 1, [Exhibit 6]
□ Scope of Defects Covered by Warranty & Warranty Period by Facility Construction □

terms of examining and analyzing defect maintenance cost data academically with focus on defects in architectural construction.

Table 2: Defect Maintenance Cost Expenditure of Company S between '02~'06

(In:KRW1K)

Classification			Plan	Act	Disburse-	Remark
			ned	ual	ment ratio	
Defect Maintenance Costs	2002	1st half	1,313,000	873,534	66.5%	
		2nd half	1,955,000	1,824,946	93.3%	
	Subtotal		3,268,000	2,698,480	82.6%	
	2003	1st half	1,662,000	683,602	41.1%	
		2nd half	1,662,000	2,216,209	133.3%	
	Subtotal		3,324,000	2,899,811	87.2%	
	2004	1st half	5,699,000	3,545,311	62.2%	
		2nd half	5,843,000	3,773,757	64.6%	
	Subtotal		11,542,000	7,319,068	63.4%	
	2005	1st half	3,235,732	2,048,170	63.3%	
		2nd half	5,947,344	5,225,568	87.9%	
	Subtotal		9,183,076	7,273,738	79.2%	
	2006	1st half	3,456,288	1,871,996	54.2%	Est. in June
		2nd half	2,992,888	2,095,022	70.0%	Est.
	Subtotal		6,449,176	3,967,018	61.5%	Est.
	Total		33,766,252	24,158,114	71.5%	

<Table 2> contains the data relating to defect maintenance cost disbursements of Company S from 2002 to 2006. As the table shows, planned amount is different from actual amount, resulting in differences in disbursement ratio between the 1st and the

2nd annual half every year. All in all, disbursement ratio is 71.5%, indicating that actual amount is less than planned amount. This indicates inefficiency of budget allocation resulting from over-estimation in budgeting process, a practice that does not receive much concern on site. However, such practice results in significant opportunity costs in effect and compromises effectiveness of budget more than it is a provision against unexpected legal proceedings over defects.

As a result, <Table 3> is the product of failure to estimate budget requirement efficiently due to shortcomings in conventional defect maintenance estimation process.

Therefore, to improve apartment defect maintenance cost estimation process, it is first necessary to study budgeting process currently in use within construction industry.

4. STUDY OF IMPROVEMENTS TO DEFECT MAINTENANCE COST ESTIMATION PROCESS

4.1 Budgeting Process by Construction Contract

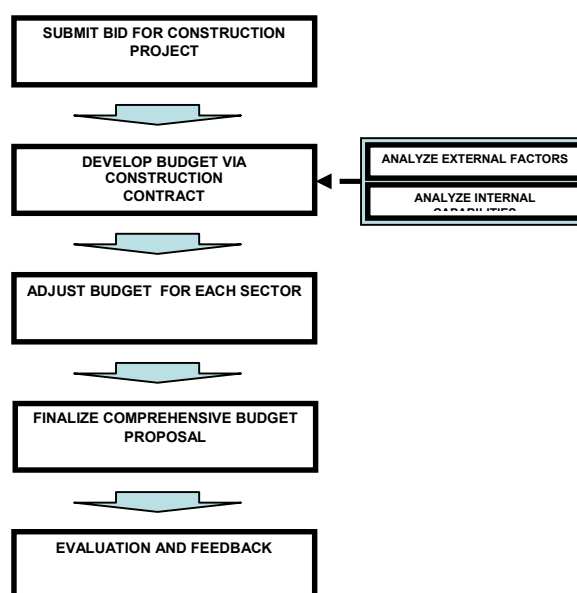


Figure 3: Budgeting Process by Construction Contract

<Fig. 3> generalizes construction project budgeting project and this research needed in-depth examination of budgeting phase by construction contract and adjustment of budget proposal for each sector to address issues in conventional defect maintenance cost estimation process.

It is important to calculate costs in reference to construction estimation standards or estimate adequate construction value on the basis of actual construction costs in bid preparation phase. However, it is of primary importance to develop budget by construction contract and adjust budget proposal for each work trade prior to construction commencement. But, construction companies rely on conventional and empirical approaches rather than systematic ones, resulting in inefficient budget operation. (See Table 2)

Therefore, this research is intended to improve inefficient budget development and adjustment practices from systematic perspective by revisiting conventional budgeting process by construction contract.

4.2 Proposed Improvement to Defect Maintenance Cost Estimation Process

<Fig. 4> describes the apartment defect maintenance cost estimation process proposed herein.

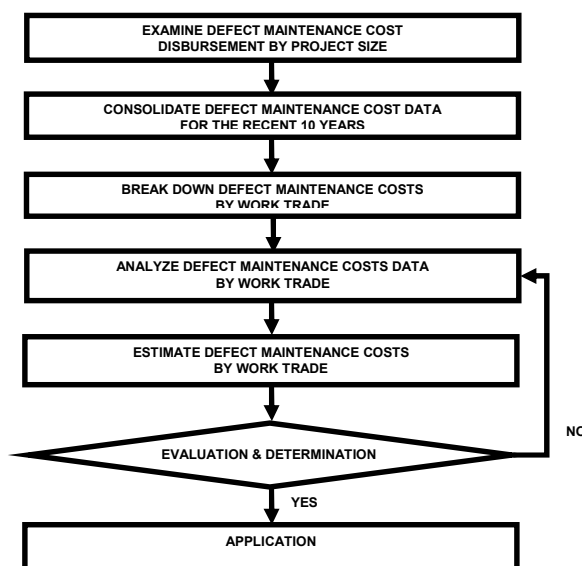


Figure 4: Apartment Defect Maintenance Cost Estimation Process

First, defect maintenance cost disbursement status is examined by project size. For example, defect maintenance cost disbursement data is collected and examined in reference to construction cost of KRW 30 billion (estimated total construction cost of apartment complex on national average).

Second, defect maintenance cost data for the recent 10 years is consolidated. This step is conducted to improve the reliability of defect maintenance cost estimation on the basis of recent data and this research is expected to reduce error of estimation by consolidating defect maintenance cost data of recent 10 years.

Third, defect maintenance cost data is broken down by work trade. As such data is broken down not only by project size but also by nature, data is broken down in this step by work trade to meet the purpose herein.

Fourth, defect maintenance costs broken down by work trade are analyzed. Extractability of data broken down previously is determined in this step as a precursor to estimation to improve reliability of data.

Fifth, defect maintenance costs by work trade is estimated. Since this step is followed by evaluation of estimated defect maintenance costs and determination of applicability, defect maintenance costs for the following year can be predicted based on the cost trends in the recent 10 years and management policy to improve reliability.

Estimation in this step is performed in reference to the following equation in principle.

$$\begin{aligned}
 E(\bar{X}) &= E\left(\frac{X_1 + \dots + X_n}{n}\right) \\
 &= \frac{1}{n} [E(X_1) + \dots + E(X_n)] \\
 &= \frac{1}{n} (n\mu) = \mu
 \end{aligned}$$

Where, $E(\bar{X})$ is the mean of extracted sample mean and μ is the population mean to be obtained. (n is the number of years.)

$$\begin{aligned} Var(\bar{X}) &= Var\left(\frac{X_1 + \dots + X_n}{n}\right) \\ &= \frac{1}{n^2} [Var(X_1 + \dots + X_n)] \\ &= \frac{1}{n^2} (n\sigma^2) = \frac{\sigma^2}{n} \end{aligned}$$

In addition, $Var(\bar{X})$ is the variance of extracted sample variance and $\frac{\sigma^2}{n}$ is population variance.

Therefore, standard error of sample mean is:

$$SE(\bar{X}) = \sqrt{Var(\bar{X})} = \frac{\sigma}{\sqrt{n}}$$

Estimated defect maintenance cost is calculated by the statistical equation in the above and representability of defect maintenance cost sample extracted from collected/examined data is validated. For example, on the basis of defect maintenance cost estimation process proposed in <Fig. 4>, defect maintenance cost data representing each year is taken as sample and standard mean is computed. As data worth 10 years is used herein, 10 standard means are identified. Mean of the 10 standard means is computed again. Obtaining standard variance or standard error with such process can produce basic data for defect maintenance cost estimation for the following year based on computed values.

Sixth, applicability of defect maintenance cost estimate is evaluated and determined in consideration of company-specific factors such as budgeting policy or construction site features.

Lastly, estimated defect maintenance costs are applied.

If defect maintenance costs are budgeted and disbursed by these steps, the purpose of apartment defect maintenance cost

estimation process improvement herein is expected to be achieved.

5. CONCLUSION

To respond to rapidly changing construction climates flexibly and manage construction projects effectively, it is essential for construction companies to develop practical framework to address construction defects and assure quality up to customer expectation. Compliance with such requirements needs to be preceded by budget operation of each work trade based on efficient budgeting process. However, there have been few attempts yet to address such fundamental issue.

Therefore, defect maintenance cost data has been examined/analyzed by work trade and Company S's budget development and disbursement process has been reviewed and improved herein. Based on such results, more substantial process for estimation of defect maintenance cost is proposed in this research.

The apartment defect maintenance cost estimation process proposed herein is expected to reduce over or under-estimation by comparing planned vs actual amount of defect maintenance cost estimated by work trade and provide for reasonable amount of defect maintenance cost.

Therefore, the systematic and efficient process proposed herein will allow for effective approach to defect maintenance of apartment housing.

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