ACCURACY IMPROVEMENT OF AN APPROXIMATE COST ESTIMATING MODEL FOR RIVER FACILITY CONSTRUCTION

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ABSTRACT: A making a decision of construction cost has important meaning and function for both contractor and owner in construction projects. Especially, it should be premised that estimating the construction cost in efficient and rational way in public construction, which is invested by government funds, for efficient execution of the budget and investment as a side of government. The systematic methodology for estimating construction cost approximately of a river facility construction project has not yet been established because of its unique characteristics including its relatively small project size in terms of cost. On this study, It collect and analyze a river facility construction historical cost data for develop an approximate cost estimating model for river applied by typical embankment section method and rate application of the others activity type. And it verify suitability of model through a that result of application of real river facility construction statement at developed model. By this study, it is expected to reasonable and systematic estimating construction cost through application of developed model.

Keywords: River Facility Construction, Approximate Cost Estimating, Design Stage, Typical Embankment Section

1. INTRODUCTION

1.1 Scope and objective of the research

While river facility construction was mainly used for the function of water-utilization and flood control to use water and to prevent inundation in the past, its environment-friendly function is emphasized recently. Although river makes our life very convenient, it is also cause for disaster that results in numerous casualties due to inundation. Due to such influence on human life, river needs to be controlled constantly. Thus, it is steadily controlled in the country under initiative of government. In the case of public construction to which national budget is allotted, forecasting proper construction cost may prevent waste of budget. Especially, forecasting construction cost at the beginning stage of project that is essential in deciding the scale of budget, is more important.

Due to diversity of topography and difficulty in standardization and typification of regional property, there is no standardized base to calculate construction cost of river facility construction unlike the other construction of civil engineering facility. All public construction projects ordered in the country with total project expense over Won 50 billion are subject to preliminary feasibility study, according to which approximate cost estimating of construction that uses basic unit price is assessed to be utilized. However, most of river facility constructions are not the object of preliminary feasibility study due to their small order scale. Further, they are subject to actual limit that there is no basic unit price to estimate approximate construction cost at the beginning stage of project. Thus, if construction cost at the beginning stage can be forecast for river facility that is constructed by basic river plan in the construction related to river facility by setting up system that assesses approximate construction cost applicable to the planning stage, risk related to construction cost may be reduced and the base that may forecast construction cost of other similar river facility at the beginning stage may be provided.

By classifying river facility construction into large construction types such as earth work, revetment work, structural work, appurtenant work and other work in calculating approximate construction cost of river facility, Shin Jung Min, et al (2008) adopted different approach method for each large construction type. While detailed representative construction types of each large construction type are selected for construction types such as earth work, revetment work and structural work to use method that calculates construction cost based on quantity information by analyzing breakdown, positive influential factors are not found in appurtenant work and other work. Thus, we selected the method that calculates construction

cost by calculating rates through analysis of portion in the total construction cost.
The objective of this research is to calculate rates of appurtenant work and other work to calculate construction cost that is more accurate than the calculation method of construction method of existing appurtenant work and other work so as to reduce the error in calculating approximate construction cost of river facility construction in the planning stage.

1.2 Scope and method of research

The calculation of approximate construction cost in the existing river facility construction uses method that calculates approximate construction cost by comparing with similar construction details or calculates the quantity of representative cross-section of river bank to get the construction cost of representative cross-section and multiplies by length (m).

Although approximate order amount may be estimated by referring to basic plan of river arrangement in the planning stage before enforcement design in constructing river, the method to calculate approximate construction cost in the basic plan of river arrangement calculates construction cost by simply applying uniform rate without reflecting the property of construction at all.

The method to calculate construction cost of appurtenant work and other work in the river facility construction of basic plan of river arrangement uses 10% of net construction cost which is calculated by calculating earth work, revetment work, structural work and demotion cost as total construction cost for the purpose of construction cost of appurtenant work. Further, 50% of total of net construction cost and construction cost is calculated as total expense. Although appurtenant work and general sundry expense occur depending on the property of construction, the method to calculate approximate construction cost in the basic plan of river arrangement does not reflect this at all.

In the river facility construction, appurtenant work and other work unlike earth work and revetment work are not consistent in their portion in the total construction cost and it is difficult to discern clear influential factor in forecasting construction cost. For this reason, Shin Jung Min et al(2008) proposed to forecast construction cost of these construction types through rates in the total construction cost.

Among the factors that constitute the river construction cost, this research applied 2 methodologies to calculate the construction cost of appurtenant work and other work. To begin with, the details of construction cost of each bank collected by applying each rate for appurtenant work and other work against the sum of construction cost of earth work, revetment work, structural work are classified in accordance with the scale of construction cost. Then, net construction cost is got via different rate that calculates rate of construction cost of appurtenant work and other work for each group and lump sum rate for the details of overall construction cost to compare error rate with standard deviation.

Unlike other work, appurtenant work is mainly composed of detailed construction types for diverse transportations and temporarily constructed object. The construction type on diverse transportations is related to earth work, revetment work and structural work which have much construction quantity in relevant construction type. Thus, regression analysis was performed to analyze the correlation of lengthening river that directly affects appurtenant work, earth work, revetment work, structural work and construction quantity.

The order of this research can be diagramed as follows. (Fig 1.)

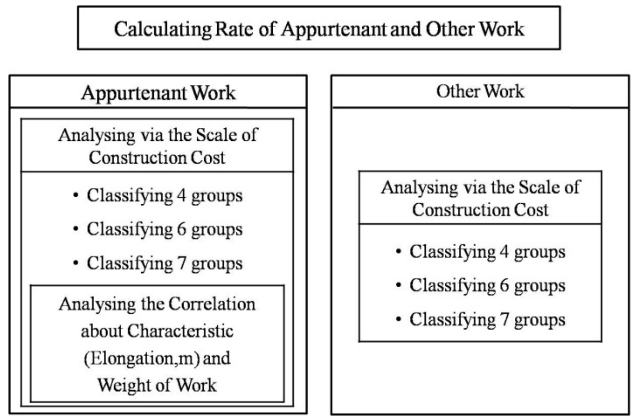

Fig 1. Research methodology

2. METHOD TO ESTIMATING APPROXIMATE CONSTRUCTION COST FOR RIVER CONSTRUCTION AND INVESTIGATION OF LITERATURE

2.1 Method to calculate approximate construction cost for river construction

Each model to calculate approximate construction cost for this model has different approach for each large construction type and construction cost is calculated in 5 large construction types including earth work, revetment work, structural work, appurtenant work and other work.

In earth work, representative construction types such as heaping soil, sand soil, remaining soil embankment, etc are drawn based on those whose portion of construction cost in the construction cost of earth work is over 5% by analyzing portion of construction cost occupied by lower detailed construction type. This is verified by consulting experts. Although leveling cutting surface and lawn grass (30 cm x 30 cm x 3cm) have construction cost below 5%, they were added as representative construction types, because they have property as such. Methodology that calculates rate by using statistical technique is applied to minor construction type, save representative construction types.

Like earth work, representative construction type of revetment work was extracted by analyzing portion. Analyzing the portion of detailed construction type, it was found that covering slope (stone net bag, fixing stone, etc) occupied quite large portion in the total construction cost of revetment work. Referring to the opinion of experts and river design practice (2006), we considered diverse construction methods of covering slope and specification.

In this model of calculating approximate construction cost, filter mat essential for revetment work and riprapping necessary for soil hardening work were added other than representative revetment work to heighten the accuracy of calculating approximate construction cost.

As structure installed in the river, structural work includes drain facility, river bed maintenance work, sluice, etc. Analyzing the details of enforcement design, it was actually difficult to grasp the representative construction types, because structural work was presented in the mixture of diverse kinds of construction types. Thus, it is required to calculate construction cost by multiplying simple unit price that pertains to place and specification in the method same to calculate construction cost of structural work in the stage of planning river arrangement.

Unlike construction cost of earth work, revetment work and structural work which is relatively quantitative factors of construction cost, the construction cost of appurtenant work and other work is calculated by rate of construction cost of earth work, revetment work and structural work (Fig 2.).

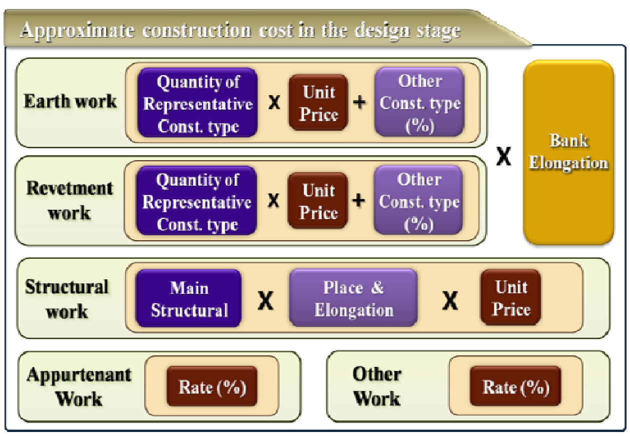

Fig 2. Method to calculate approximate construction cost in the design stage

2.2 Investigating literature

Forecasting construction cost is very important for client to set proper budget and for contractor to forecast rational bid price (Ji Se Hyun, et al, 2008). Since 80 % of total cost is decided in planning stage, it is very important to forecast construction cost at the beginning stage for decision making.

With respect to the propriety of approximate estimate model, Kim Byung Soo et al(2007) raised importance of grasping construction cost of each project, namely the factors that affect the degree of influence of construction cost for each influential factor. In calculating the approximate construction charge in the planning stage of RC rigid frame bridge, breast wall work and groundwork that occupy large portion in the construction cost was analyzed as characteristic construction type of RC rigid frame bridge and considered as influential factor.

Presenting the methodology that utilizes correction coefficient such as capacity, time, region, productivity, etc to use record of former performance in estimating plant construction, Woo Sung Kwon, et al (2001) also reflected the property of plant construction.

When constructing road, lane, cross-section and road elongation are enumerated as representative influential factors and the composition of construction type is relatively simple. Thus, Kim Seon Kuk, et al (2000) tried to construct exemplary model of construction cost through regression analysis and Choi Seok Jin, et al (2008) utilized Case-Based Reasoning to present model forecasting construction cost at the beginning stage of project so as to forecast construction cost in broad range. Even in the construction of same kind, the construction situation and results are diverse, depending on the scale, region and time. Therefore, diverse techniques and methodologies such as regression analysis, correction coefficient and case-based reasoning are applied to get exact result of approximate estimate of constructed facility, namely, calculating approximate construction cost. In this research, methods with different applying rates for each scale of construction cost are applied for correlation analysis through regression analysis with appurtenant work, river elongation, earth work, revetment work, structural work and forecast of construction cost with appurtenant work and other work.

3. CALCULATING RATE OF APPURTENANT WORK CONSTRUCTION COST

3.1 Calculating rate of appurtenant work in accordance with the scale of construction cost

In the analysis of rate of appurtenant work construction cost, 66 data without river elongation details and construction cost of appurtenant work were excluded out of the 231 cases of total construction data and the ratio of appurtenant work construction cost for net construction cost was calculated so that 149 cases of performance construction data could be used, excluding the value in top 5% and bottom 5%. Classifying them into 4, 6 and 7 groups depending on the scale of net construction cost, the different rate, i.e., the rate of construction cost against the sum of construction cost of earth work, revetment work and structural work in each construction cost group and the lump sum rate, i.e., the rate of appurtenant work construction cost against the sum of construction cost of earth work, revetment work and structural work of total data were applied to calculate the net construction cost so as to analyze each error rate and standard deviation.

3.1.1 Classifying the scale of construction cost into 4 groups

When classifying total construction cost into 4 groups in the range of ‘below 1 billion’ ‘1 billion~2 billion’ ‘2 billion~4 billion’ and ‘over 4 billion’, the number of data in each group was 39, 42, 37 and 31 and the rates applied to each group were 13.24%, 15.11%, 8.78% and 8.51%. The error rate and standard deviation when applying lump sum rate and different rate are listed in Table 1.

Table 1. The scale of construction cost is classified into 4 groups.

Const. Cost(₩)		~1 bil.	1 bil.~ 2 bil.	2 bil.~ 4 bil.	4 bil.~
No. of data		39	42	37	31
A/Rate		13.24%	15.11%	8.78%	8.51%
S/D		8.87%	10.23%	5.87%	5.37%
L/S Rate		11.68%			
E/R	D/R	6.08%	6.54%	3.56%	3.43%
	L/R	6.69%	6.26%	4.57%	4.41%
S/D	D/R	3.08%	4.12%	3.07%	2.46%
	L/R	3.22%	4.73%	3.23%	2.52%

When applying different rate to construction with net construction cost below Won 1 billion, error rate is 6.80%, which is slightly higher than 6.69%, the error rate when applying lump sum rate. In standard deviation, applying different rate shows aspect of lower error rate and the same aspect is kept in the construction amounting to Won 1~2 billion. In the construction group amounting to Won 2~4 billion and over Won 4 billion, both average rate and error rate of standard deviation were reduced (Fig 3.).

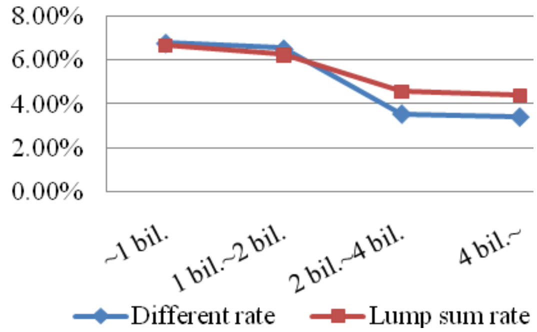

Fig 3. Comparing error rate between different rate and lump sum rate (4 groups)

3.1.2 Classifying the scale of construction cost into 6 groups

Classifying net construction cost into 6 groups, i.e., 'below 1 billion' '1billion~2 billion' '2 billion~3 billion' '3 billion~4 billion' '4 billion~5 billion' and 'over 5 billion', we analyzed the error rate and standard deviation of lump sum rate and different rate in each group. The average rates pertaining to each group were 13.24%, 15.11%, 8.51%, 9.18%, 10.04% and 7.89%. The error rate and standard deviation when applying lump sum rate and different rate are listed in Table 2.

When net construction cost is less than Won 1 billion and between Won 1 billion and 2 billion, the result showed lower error rate when applying lump sum rate. This difference in error rate is slight different from that when applying different rate. It was obviously found that different rate presented more accurate result over Won 2 billion (Fig 4.)

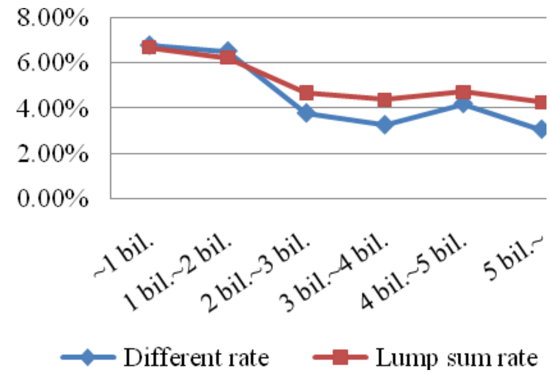

Fig 4. Comparing error rate between different rate and lump sum rate (6 groups)

Table 2. The scale of construction cost is classified into 6 groups.

Const. Cost(₩)		~1 bil.	1 bil.~2 bil.	2 bil.~3 bil.	3 bil.~4 bil.	4 bil.~5 bil.	5 bil.~
Number of data		39 ea	42 ea	22 ea	15 ea	9 ea	22 ea
Average rate		13.24%	15.11%	8.51%	9.18%	10.04%	7.89%
Std. Deviation		8.87%	10.23%	5.37%	6.71%	6.53%	4.85%
Lump sum rate		11.68%					
Error rate	different rate	6.80%	6.54%	3.79%	3.26%	4.21%	3.07%
	lump sum rate	6.69%	6.26%	4.69%	4.40%	4.73%	4.29%
Std. Deviation	different rate	3.08%	4.12%	2.52%	6.71%	2.61%	4.85%
	lump sum rate	3.22%	4.73%	3.03%	6.71%	2.41%	4.85%

3.1.3 Classifying the scale of construction cost into 7 groups

Classifying net construction cost into 7 groups, i.e., 'below 0.5 billion' '0.5 billion~1 billion' '1billion~2 billion' '2 billion~3 billion' '3 billion~4 billion' '4 billion~5 billion' and 'over 5 billion', we analyzed the error rate and standard deviation of lump sum rate and different rate in each group. The average rates pertaining to each group were 15.81%, 10.53%, 15.11%, 8.51%, 9.18%, 10.04% and 7.89%. The error rate and standard deviation when applying lump sum rate and different rate are listed in Table 3. The rates could be calculated in further details than 4 or 6 groups. This may be regarded as rate applying method that which is improved from methodology that calculates appurtenant work construction cost by applying lump sum rate (Fig 5.)

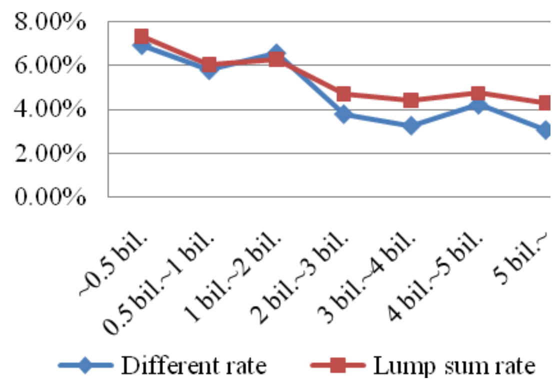

Fig 5. Comparing error rate between different rate and lump sum rate (7 groups)

Table 3. The scale of construction cost is classified into 7 groups.

Const. Cost(₩)		~0.5 bil.	0.5 bil. ~1 bil.	1 bil. ~2 bil.	2 bil. ~3 bil.	3 bil. ~4 bil.	4 bil. ~5 bil.	5 bil. ~
Number of data		20 ea	19 ea	42 ea	22 ea	15 ea	9 ea	22 ea
Average rate		15.81%	10.53%	15.11%	8.51%	9.18%	10.04%	7.89%
Std. Deviation		9.46%	7.50%	10.23%	5.37%	6.71%	6.53%	4.85%
Lump sum rate		11.68%						
Error rate	different rate	6.90%	5.77%	6.54%	3.79%	3.26%	4.21%	3.07%
	lump sum rate	7.30%	6.03%	6.26%	4.69%	4.40%	4.73%	4.29%
Std. Deviation	different rate	3.58%	2.64%	4.12%	2.52%	3.77%	2.61%	2.39%
	lump sum rate	3.71%	2.55%	4.73%	3.03%	3.61%	2.41%	2.61%

3.2 Calculating rate of appurtenant work by using regression equation

Analyzing correlation based on the construction amount and elongation of earth work, revetment work and structural work, we applied the methodology that forecasts construction cost by using regression analysis. Since influential factors that may affect approximate construction cost of river facility, e.g., planned river width besides elongation, bank width, etc were excluded from the targets to which regression analysis was to be applied due to many unmeasured values. We analyzed by dividing into the case when they were not classified as per scale of construction cost and the case when they were classified into 6 groups. In the case of rate analysis, they were classified into 7 groups. However, in the case of regression analysis, they were not classified into 7 groups to prevent the number of data from decreasing.

3.2.1 Unclassified per the scale of construction cost

When construction cost was generally applied without classification as per scale, the correlation between the dependent variable, i.e., construction cost of appurtenant work and the independent variable, i.e., construction cost of earth work, revetment work and structural work and the elongation was analyzed and the regression model was drawn(Table 4.). We used 149 performance construction data as we did when calculating rates.

Table 4. Regression Model

R	R^2	Adjusted R^2	Std. Error
0.630	0.397	0.380	154,184,905

Although determinant coefficient(R^2) of drawn regression model was 0.397, having correlation with dependent variables of independent variables, it seems that they do not explain so effectively.

3.2.2 Classifying the scale of construction cost into 6 groups

Classifying net construction cost into 6 groups, i.e., 'below 1 billion' '1billion~2 billion' '2 billion~3 billion' '3 billion~4 billion' '4 billion~5 billion' and 'over 5 billion', we analyzed the construction cost of appurtenant work (the respective dependent variables), the construction cost of independent variables (earth work, revetment work and structural work) and correlation with elongation and drew the regression model (Table 5.)

According to the analysis, the explanatory power of independent variables for dependent variables was lower than the case where they were not classified for each scale except the case of Won 4 billion~5 billion. This may be due to irregular portion of construction cost of appurtenant work in the total construction cost and the low number of data used in the analysis.

Table 5. The scale of construction cost is classified into 6 groups.

Const. Cost(₩)	~1 bil.	1 bil. ~2 bil.	2 bil. ~3 bil.	3 bil. ~4 bil.	4 bil. ~5 bil.	5 bil.~
Number of data	39 ea	42 ea	22 ea	15 ea	9 ea	22 ea
R	0.296	0.087	0.310	0.438	0.723	0.236
R^2	0.088	0.008	0.096	0.192	0.523	0.056
Adjusted R^2	-0.020	-0.100	-0.116	-0.131	0.047	-0.167
Std. Error	37,201,978	113,461,841	101,301,278	184,401,755	202,582,547	300,065,531

4. CALCULATING CONSTRUCTION COST OF OTHER WORK

When analyzing the rate of construction cost of other work, 136 performance construction data were used after excluding the value in top 5% and bottom 5% by calculating the ratio of appurtenant work construction cost for net construction cost except 80 data omitted in the construction cost of elongation information of river and other work out of 231 total performance construction data. Classifying them into 4 or 6 groups as per the scale of net construction cost, we applied different rate and lump sum rate to each group of construction cost to calculate net construction cost so as to analyze each error rate and standard deviation.

4.1 Classifying the scale of construction cost into 4 groups

When we classified net construction cost into 4 groups, i.e., 'below 1 billion' '1billion~2 billion' '2 billion~4 billion' and 'over 4 billion', the number of data pertaining to each group was 29, 41, 39 and 27 and the applied rates for each group were 9.47%, 9.26%, 8.12% and 12.03%. The error rate and standard deviation when applying lump sum rate and different rate are listed in Table 6.

Table 6. The scale of construction cost is classified into 4 groups.

Const. Cost(₩)		~1 bil.	1 bil.~ 2 bil.	2 bil.~ 4 bil.	4 bil.~
No. of data		29 ea	41 ea	39 ea	27 ea
Avg. Rate		9.47%	9.26%	8.12%	12.03%
Std. Dev.		7.36%	8.19%	5.39%	6.39%
L/S rate		9.53%			
Er Rt	D/R	5.04%	5.00%	3.83%	4.51%
	L/R	5.05%	5.07%	4.05%	4.52%
S/D	D/R	3.15%	3.68%	2.32%	2.75%
	L/R	3.14%	3.64%	2.51%	3.06%

If different rate is applied when net construction cost is below Won 1 billion and over Won 4 billion, the error rate is 5.04% and 4.51%, which is slightly lower than 5.05% and 4.52%, the error rate when applying lump sum rate. We found that error rate of average rate and standard deviation is lower than the rate when applying lump sum rate, if different rate is applied when net construction cost is over Won 1 billion and below Won 4 billion (Fig 6.).

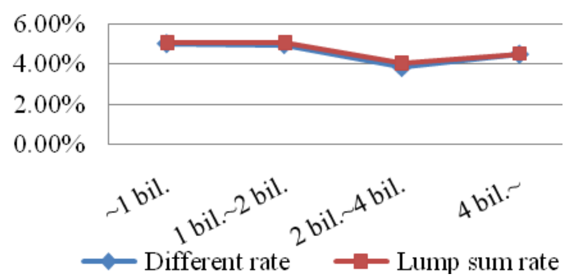

Fig 6. Comparing error rate between different rate and lump sum rate (4 groups)

4.2 Classifying the scale of construction cost into 6 groups

Classifying net construction cost into 6 groups, i.e., 'below 1 billion' '1billion~2 billion' '2 billion~3 billion' '3 billion~4 billion' '4 billion~5 billion' and 'over 5 billion', we analyzed the error rate and standard deviation of lump sum rate and different rate in each group. The average rates pertaining to each group were 13.24%, 15.11%, 8.51%, 9.18%, 10.04% and 7.89%. The error rate when applying different rate with net construction cost is Won 4 billion ~ Won 5 billion in 4.87%, which is higher than 4.40%, the error rate when applying lump sum rate. In the other group of construction cost, both error rates of average rate and standard deviation are better than those when applying lump sum rate (Fig 7.).

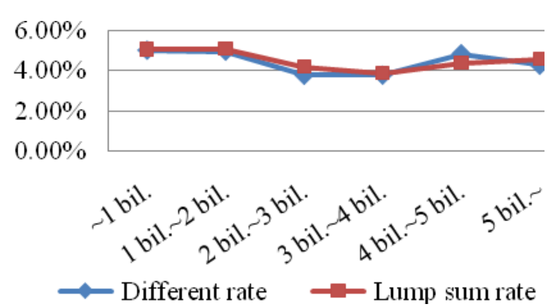

Fig 7. Comparing error rate between different rate and lump sum rate (6 groups)

Table 7. The scale of construction cost is classified into 6 groups.

Const. Cost(₩)		~1 bil.	1 bil.~2 bil.	2 bil.~3 bil.	3 bil.~4 bil.	4 bil.~5 bil.	5 bil.~
Number of data		29 ea	41 ea	21 ea	18 ea	9 ea	18 ea
Average rate		9.47%	9.26%	7.64%	8.68%	11.68%	12.20%
Std. Deviation		7.36%	8.19%	5.19%	5.71%	7.06%	6.23%
Lump sum rate		9.53%					
Error rate	different rate	5.04%	5.00%	3.78%	3.79%	4.87%	4.29%
	lump sum rate	5.05%	5.07%	4.18%	3.89%	4.40%	4.59%
Std. Deviation	different rate	3.15%	3.68%	2.10%	2.74%	2.41%	2.97%
	lump sum rate	3.14%	3.64%	2.51%	2.85%	3.33%	3.01%

Table 8. The scale of construction cost is classified into 7 groups.

Const. Cost(₩)		~0.5 bil.	0.5 bil. ~1 bil.	1 bil. ~2 bil.	2 bil. ~3 bil.	3 bil. ~4 bil.	4 bil. ~5 bil.	5 bil. ~
Number of data		12 ea	17 ea	41 ea	21 ea	18 ea	9 ea	18 ea
Average rate		10.81%	8.53%	9.26%	7.64%	8.68%	11.68%	12.20%
Std. Deviation		8.43%	6.61%	8.19%	5.19%	5.71%	7.06%	6.23%
Lump sum rate		9.53%						
Error rate	different rate	5.30%	4.69%	5.00%	3.78%	3.79%	4.87%	4.29%
	lump sum rate	5.29%	4.88%	5.07%	4.18%	3.89%	4.40%	4.59%
Std. Deviation	different rate	3.68%	2.76%	3.68%	2.10%	2.74%	2.41%	2.97%
	lump sum rate	3.76%	2.74%	3.64%	2.23%	2.85%	3.33%	3.01%

4.3 Classifying the scale of construction cost into 7 groups

Classifying net construction cost into 7 groups, i.e., 'below 0.5 billion' '0.5 billion~1 billion' '1billion~2 billion' '2 billion~3 billion' '3 billion~4 billion' '4 billion~5 billion' and 'over 5 billion', we analyzed the error rate and standard deviation of lump sum rate and different rate in each group. The average rates pertaining to each group were 10.81%, 8.53%, 9.26%, 7.64%, 8.68%, 11.68% and 12.20%. The error rate and standard deviation when applying lump sum rate and different rate are listed in Table 8. The error rate when applying different rate with net construction cost in Won 4 billion ~ Won 5 billion is 4.87%, which is higher than 4.40%, the error rate when applying lump sum rate. In the other section, different rate shows lower error rate than this lump sum rate (Fig 8).

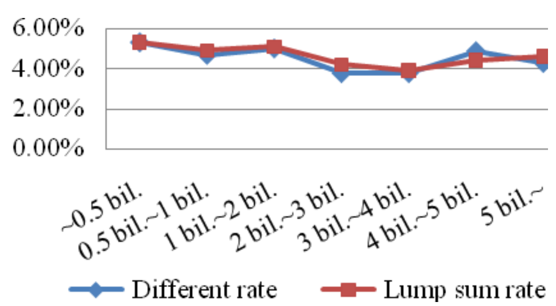

Fig 8. Comparing error rate between different rate and lump sum rate (7 groups)

5. CONCLUSIONS

The detailed representative construction type and place or specification of structure of earth work, revetment work or structural work are the definite influential factors when forecasting each construction cost. Especially, the construction cost of detailed representative construction type in earth work or revetment work shows coverage approximate to 90% of each construction cost of construction type (Fig 9., Fig 10.).

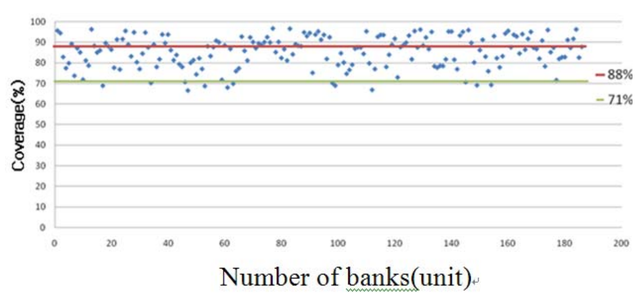

Fig 9. Coverage of representative construction type of earth work(%)

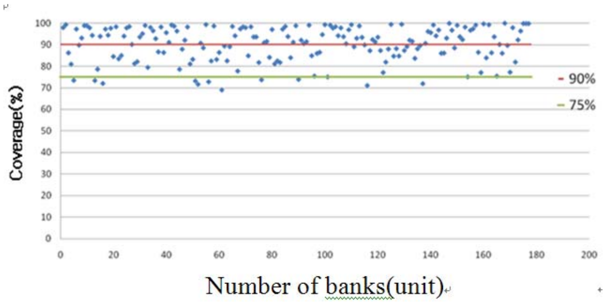

Fig 10. Coverage of representative construction type of revetment work (%)

Since appurtenant work or other work has no definite influential factor such as detailed representative construction type in forecasting construction cost, however, earth work, revetment work, structural work and demolition cost are calculated as gross construction cost for basic plan of river arrangement and 10% of the calculated net construction cost is used as appurtenant work construction cost.

As construction type on the transportation related to the quantity of earth work or revetment work was included in appurtenant work, appurtenant work construction cost was set up as independent variable and earth work, revetment work, structural work and river elongation were set up as dependent variables for regression analysis. However, the explanatory power of independent variables for dependent variables was not demonstrated, because the determinant coefficient (R2) of regression model is below 0.5. Thus, the calculation by rate of appurtenant work construction cost for sum of construction cost of earth work, revetment work, structural work may be more rational than method by regression analysis in forecasting construction cost of appurtenant work or other work. Furthermore, different rate, i.e., the rate of appurtenant work construction cost for sum of construction cost of earth work, revetment work, structural work as per scale of construction cost rather than lump sum rate of total data presented more accurate result as verified when the scale of construction cost is further classified. In this research, appurtenant work and other work respectively used 149 and 136 cases of performance construction data to verify the forecast of construction of appurtenant work and other work by applying different rate. If more data is prepared later as performance construction DB is constructed for river facility construction, construction cost of appurtenant work and other work may be forecast more accurately, thereby contributing to calculate approximate construction cost of river facility more accurately than now.

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REFERENCES

[1] Shin, J. M., Woo, S. K., Lee, S. W., Kim, O. K., “Development of an Approximate Cost Estimating Framework for River Facility Construction at Planning Stage”, KSCE, Vol.28(3D), pp.371-381, 2008.
[2] Woo, S. K., Jung, Y. S., “Development and Application of Cost Adjustment Factor Database for an Approximate Cost Estimating System”, KSCE, Vol.21 (5-D), pp.695-702, 2001.
[3] Kim, S. K., Shin, J. S., Koo, I. W., Kim, Y. G., “A Statistical Cost Model for Road Construction Project at Planning Stage”, KSCE, Vol.20(2-D), pp.171-180, 2000.
[4] Choi, S. J., Yeo, D. H., Han, S. H., “Cost Estimating Model for Road Construction Project in Planning Phases by Using Case-Based Reasoning”, Proceedings of 2008 KSCE Annual Conference & Civil Exposition, pp.1900-1903, 2008.
[5] Ji, S. H., Park, M. S., Lee, H. S., Seong, K. H., Yoon, Y. S., “Method of Quantity Data Analysis for Building Construction Cost Estimation : Focusing on Finish Work of Public Apartment Project”, Korea Journal of Construction Engineering and Management, Vol9(6), pp.235-243, 2008
[6] Kim, B. S., Lee, H. S., Kim, K. H., Lim, H. D., “A Base Study on the Approximate Cost Estimation Model of Design Phase for RC Rahmen Bridge”, Proceedings of 2007 KSCE Annual Conference & Civil Exposition, pp.3175-3178, 2007
[7] Goomibook, “River Design Practice”, 2006