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EVALUATION OF THE PHYSICAL CONSTRUCTION BUDGET FOR THE DEVELOPMENT OF STATE JUNIOR HIGH SCHOOL (SMPN) 14 IN BANDUNG

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ABSTRACT

This study aims to evaluate the accuracy of the physical budget ceiling for the construction of SMP Negeri 14 Bandung at the conceptual stage using a conceptual cost estimation approach and identify parameters that influence the level of cost estimation accuracy using the Relative Importance Index (RII) method. Cost estimates were calculated using a parametric method, with data tabulation based on parameters in PUPR Ministerial Regulation No. 22/PRT/M/2018. A multicriteria assessment was conducted by referring to previous studies regarding the accuracy limits of cost estimates. Analysis was conducted using validity, reliability, correlation, and RII calculations to identify the parameters most influential on cost estimation accuracy. The results showed that the conceptual cost estimate was Rp 8,415,480,000.00, while the physical budget ceiling was set at Rp 7,410,370,000.00. There was a difference of Rp 1,005,110,000.00 (-11.94%), indicating that the budget ceiling was lower than the estimate, thus being assessed as "not accurate enough" according to the accuracy category.

Keywords: *Budget ceiling, physical construction, evaluation, school buildings*

EVALUASI ANGGARAN KONSTRUKSI FISIK UNTUK PEMBANGUNAN SEKOLAH MENENGAH PERTAMA NEGERI (SMPN) 14 DI BANDUNG

ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi akurasi batas anggaran fisik untuk pembangunan SMP Negeri 14 Bandung pada tahap konseptual menggunakan pendekatan perkiraan biaya konseptual, serta mengidentifikasi parameter yang mempengaruhi tingkat akurasi perkiraan biaya menggunakan metode Indeks Penting Relatif (RII). Perkiraan biaya dihitung menggunakan metode parametrik, dengan pencatatan data berdasarkan parameter dalam Peraturan Menteri PUPR Nomor 22/PRT/M/2018. Penilaian multikriteria dilakukan dengan merujuk pada studi sebelumnya mengenai batas akurasi perkiraan biaya. Analisis dilakukan menggunakan validitas, reliabilitas, korelasi, dan perhitungan RII untuk mengidentifikasi parameter yang paling berpengaruh terhadap akurasi perkiraan biaya. Hasil menunjukkan bahwa perkiraan biaya konseptual sebesar Rp 8.415.480.000,00, sementara batas anggaran fisik ditetapkan sebesar Rp 7.410.370.000,00. Terdapat selisih sebesar Rp 1.005.110.000,00 (-11,94%), menunjukkan bahwa batas anggaran lebih rendah dari perkiraan, sehingga dinilai sebagai "tidak cukup akurat" menurut kategori akurasi.

Kata kunci: *Batas anggaran, konstruksi fisik, evaluasi, gedung sekolah.*

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INTRODUCTION

Accuracy in determining budget ceilings greatly affects the efficiency of government spending and the quality of development. According to Molenaar et al. (2000), budget ceilings need to be evaluated to ensure that they are in line with actual needs in the field and project conditions. One reason for this is that technical parameters and project characteristics are not fully recognized when determining the ceiling. According to AACE International (2016), various factors such as the shape and function of the building, structural systems, spatial programs, and technical standards of the project greatly influence budget requirements. If these factors are not properly considered, the budget ceiling risks not reflecting the project conditions realistically.

Lapangan Supratman Number 8, Bandung Wetan District, Bandung City, is one of the government-funded educational building construction projects. This project is a multi-story building, so structurally it has different technical requirements compared to a single-story building. In addition, the construction of public schools must refer to the standards for facilities and infrastructure specified in the Minister of Education and Culture Regulation Number 24 of 2007. According to RICS (2019), technical standards in public facility projects such as schools affect the composition and volume of work and have a direct impact on physical costs. Therefore, determining the budget ceiling must take into account the exact scale of the project.

If MEP requirements are not calculated accurately from the outset, there is a risk of budget shortfalls, which ultimately affect the quality of the building (Syahra et al., 2021). Without checking the physical budget amount, the possibility of a mismatch between the fund allocation and project requirements will remain. This not only reduces the effectiveness of public fund use but also affects the smooth running and quality of construction projects. Therefore, it is necessary to check the accuracy of cost estimates at the conceptual stage with the predetermined physical budget amount and the parameters that affect the level of suitability.

RESEARCH METHODS

1. Data Analysis Methods

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Conceptual Stage Cost Estimate Accuracy Analysis Method. The method used to analyze the data is to evaluate the estimated costs against the budget ceiling using a parametric method. The steps are as follows:

1) General Data and Project Information

At the conceptual stage, cost estimates require a complete understanding of the project conditions. Therefore, the first step is to identify and describe the general data and relevant technical information of the project. The following is the table format used as a reference in collecting and compiling project data:

Table 2.1 General Data

General Data	
Owner	:
Budget	:
Building Function	:
Building Classification	:
Work Contract	:
Work Period	:

Source: PUPR Ministerial Regulation Number 22/PRT/M/2018

Table 2.2 Project Information

Project Information	
Project Location	:
Land area	:
Building area	:
Floor Area Ratio (FAR)	:
Building Height (KLB)	:
Building Height	:
Floor Height Coefficient	:
Ceiling (HPS)* Owner	:
Highest Unit Price Standard (SHST)	:
Contractor Contract Value (NKK)	:
VAT	:

Source: Minister of Public Works and Public Housing Regulation No. 22/PRT/M/2018

2) Budget Ceiling Evaluation

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The budget ceiling evaluation is carried out in advance to determine the price values and percentages that support the budget ceiling. These values include the State Building Unit Price (HSBGN), the Highest Unit Price Standard (SHST), non-standard prices, and the percentage of non-standard prices. Furthermore, the difference between HSBGN and SHST is referred to as the non-standard price. The following is the budget ceiling evaluation calculation format used in the study:

Table 2.3 Budget Ceiling Evaluation Calculation

No	Information	Calculation
1.	Building Unit Price (HSBGN)/m2	= (NKK – VAT 11%) / Building Area = ……. (IDR)
2.	Standard Price (SHST)	= SHST value for 2023 = ... (IDR)
3.	Non Standard Prices	= HSBGN – SHST = ... (IDR)
4.	Non-Standard Price Percentage (max. 150%)	= (Non-Standard Price / Standard Price) x 100% = (……. / ……) x 100% = …….%

Source: Minister of Public Works and Public Housing Regulation Number 22/PRT/M/2018

3) Calculation of Physical Building Costs

The calculation of physical building costs is based on general data and project information, such as building area, building classification, and building height coefficient value. The calculation of physical building costs begins by finding the Standard and Non-Standard Work Price (HPSNS) value, which is then added to the Highest Unit Price Standard (SHST) and non-standard prices. After that, the State Building Unit Price (HSBGN) is calculated. The HSBGN value is obtained from the HPSNS value multiplied by the Building Height Coefficient (KKB) value.

Table 2.4 Physical Building Costs

No	Information	Calculation
1.	Standard Price (SHST)	= ….. (IDR/m²)
2.	Non-Standard Price (Max. Percentage 150%)	= (% Non-Standard Work / (SHST X Building Area)) x 100% =….IDR

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3.	Standard and NonStandard Work Prices (HPSNS)	= SHST + Non-Standard Price =….. (IDR/m²)
4.	Building Height Coefficient (KKB)	=….. (refer to Minister of Public Works and Public Housing Regulation Number 22/PRT/M/2018)
5.	Total HSBGN	=HPSNS x KKB =….. (IDR/m²)
6.	Total Physical Cost of Buildings	=HSBGN x Building Area =….. (IDR)

Source: Minister of Public Works and Public Housing Regulation No. 22/PRT/M/2018

4) Non-Standard Price Percentage Analysis

Population growth has a low impact on the cost components used for supporting or complementary work of the main building structure, such as mechanical, electrical, and plumbing (MEP), fire protection systems, lightning protection systems, interior work, and other supporting infrastructure. To identify work in the non-standard category, an approach based on percentage intervals is used for three cost components, namely standard physical construction costs (X), highest standard unit prices (Y), and quality improvement components (Z). The following table details nonstandard work units and their percentage intervals:

Table 2.5 Non-Standard Price Percentage

No	Type of work	Percentage
1	Air Conditioning System	7 – 15% of X
2	Elevators and Escalators	8 – 14% of X
3	Solar System	2 – 4% of X
4	Telephone and PABX Installation	1 – 3% of X
5	Information Technology (IT) Systems	6 – 11% of X
6	Electrical Installation (including Generator)	7 – 12% of X
7	Fire Suppression System	7 – 12% of X
8	Special Lightning Rod Installation	1 – 2% of X
9	Wastewater Treatment Plant (WWTP)	1 – 2% of X

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10	Interior Work including Furniture	15 – 25% of X
11	Combustion Gas System	1 – 2% of X
12	Medical Gas Systems	2 – 4% of X
13	Termite Control System	1 – 3% of X
14	Deep Foundation	7 – 12% of X
15	Facilities for Persons with Disabilities and Special Needs	3 – 5% of X
16	Environmental Facilities and Infrastructure	3 – 8% of X
17	Basement (per square meter)	120% of Y
18	Building Quality Improvement Work	0 – 30% of Z
Total Presentation Of Non-Standard Work		Maximum 150%

Source: Regulation of the Minister of Public Works and Housing No. 22/PRT/M/2018.

Explanation

X : Total physical construction cost of standard work

Y : Highest standard unit price/m2

Z : Total cost of quality improvement work components

5) Physical Construction Cost Analysis

After obtaining the percentage of non-standard work and calculating the physical cost of the building, the next step is to add the quality improvement cost component. Then, the total physical construction cost is calculated by adding the physical cost of the building and the quality improvement cost.

The calculation format can be seen in Table 2.6 below:

Table 2.6 Physical Construction Cost Analysis

Component	Value (IDR)
Total Physical Building Cost	
Quality Improvement Costs	
Total cost	
VAT 11%	

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Total Cost + VAT 11%	
Rounding	

Source: Minister of Public Works and Public Housing Regulation No. 22/PRT/M/2018

6) Accuracy of Budget Ceiling Value

This accuracy shows how close the estimated value or analysis results are to the previously determined budget ceiling (HPS Owner). Accuracy is calculated by determining the difference between the budget ceiling (HPS Owner) and the budget analysis results (corrected value). This difference is then expressed as a percentage of the corrected ceiling value in the following table:

Table 2.7 Budget Ceiling Value Accuracy

Component	Value
Budget Ceiling Value/HPS Owner	(IDR)
Budget Ceiling Analysis Results	(IDR)
Budget Ceiling Difference	(IDR)
Budget Ceiling Accuracy Value	%

Source: PUPR Ministerial Regulation No. 22/PRT/M/2018

In addition to using a parametric approach, this study also uses a multi-criteria analysis method to evaluate the accuracy category of cost estimates. This approach refers to methods that have been used in several previous studies, each providing a range of cost estimate accuracy. This multi-criteria method allows researchers to assess cost evaluation results more objectively, as it considers various empirical references that have been tested in previous studies.

2. Discussion Method for Analysis Results

Discussion Method for Conceptual Stage Cost Estimation Accuracy

The discussion on the accuracy of cost estimates at the conceptual stage is carried out by comparing the estimated physical construction costs with the budget ceiling (HPS Owner). This comparison is presented in tabular form to make it easier to identify differences in values. The percentage difference is used as the basis for assessing the level of accuracy. The formula used to assess accuracy is as follows:

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Table 2.8 Discussion of Budget Ceiling Accuracy

Budget Ceiling Accuracy		
No	Information	Calculation
1.	Budget Ceiling Difference	Budget Ceiling/HPS Owner – Budget Ceiling Analysis Results
2.	Budget Ceiling Accuracy Value	(Budget Ceiling/Owner's HPS : Budget Ceiling Analysis Results) x 100%

Source: (Ministry of Public Works and Public Housing Regulation Number 22/PRT/M/2018)

RESULTS AND DISCUSSION

1. Data Analysis

Analysis of Conceptual Stage Cost Estimate Accuracy

The evaluation of cost estimates at the conceptual stage against the budget ceiling using the parametric method was carried out using the following calculation steps:

Table 3.1 Data Tabulation Results

1.1	Project Description		
	- Owner	:	Bandung City Education Office
	- Budget	:	2023 Regional Budget
	- Building Function	:	Educational Building
	- Building Classification	:	Not Simple
	- Work Contract	:	Unit Price (Build Contract)
	- Work Duration	:	36 days
1.2	Project Information		
	- Project Location	:	Jalan Lap. Supratman No. 8, Cihapit, Bandung Wetan Subdistrict, Bandung City, West Java 40114
	- Land Area	:	± 1.220,00 m^2
	- Building Area	:	± 732,00 m^2
	- Floor Area Ratio (FAR)	:	55%
-	Building Coverage Ratio (BCR)	:	4,35
-	Building Height (BH)**	:	2 Floors
-	Building Height Coefficient	:	1,050

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	(BHC)		
-	Ceiling (HPS)* Owner	:	IDR 7.410.370.000,00
-	HPS minus 11% VAT	:	IDR 6.595.229.300,00
-	Highest Unit Price Standard (SHST)	:	IDR 4.847.200,00
-	Contractor Contract Value (NKK)*	:	5.926.650.000,00
-	NKK minus 11% VAT	:	5.274.718.500,00
-	NKK/HPS Percentage	:	79,98
1.3	Budget Ceiling Evaluation		
-	Building Unit Price (HSBGN) /m2	:	IDR 7.205.899,59
-	Standard Price (SHST)	:	IDR 4.847.200,00
-	Non-Standard Price	:	IDR 2.358.699,59
-	Non-Standard Price Percentage (max. 150%)	:	48,66 %
1.4	Budget Ceiling Analysis		
a.	Physical Building Cost Analysis		
-	Standard Price (SHST)	:	IDR 4.847.200,00
-	Non-Standard Price (max. 150% percentage)	:	IDR 4.120.120,00
-	Standard and Non-Standard Work Price (HPSNS)	:	IDR 8.967.320,00
-	Total HSBGN	:	IDR 9.415.686,00
-	Total Physical Building Costs	:	IDR 6.892.282.152,00
b.	Analysis of Non-Standard Price Percentage		

NO	TYPE OF WORK	PERCENTAGE INTERVAL	PERCENTAGE WORK
1	Air Conditioning Equipment	7-15 %	7%
2	Elevator/Escalator	8 - 14 %	0%
3	Solar System	2 - 4%	3%
4	Telephone and PABX	1 - 3 %	3%
5	IT Installation (Information & Technology)	6 - 11 %	9%
6	Electrical (including Generator)	7 - 12 %	7%
7	Fire Protection System	7 - 12 %	7%
8	Special Lightning Protection System	1 - 2 %	1%
9	Wastewater Treatment Plant (WWTP)	1-2 %	1%
10	Interior (including Furniture)	15 - 25 %	15%

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11	Combustion Gas	1 -2 %	1%
12	Medical Gas	2 - 4 %	0%
13	Termite Prevention	1 - 3 %	3%
14	Deep Foundation	7 - 12 %	7%
15	Facilities for Persons with Disabilities & Special Needs	3 - 5%	3%
16	Environmental Infrastructure	3 - 8 %	8%
TOTAL PERCENTAGE OF WORK NON STANDARD			75%
AGAINST X			0%
1	Basement/m2 120%		
TOTAL PERCENTAGE NON-STANDARD WORK TO Y			0%
1	Quality Improvement 0-30%		10%
TOTAL PERCENTAGE NON-STANDARD WORK TO Z			10%
TOTAL PERCENTAGE OF NON-STANDARD WORK			85%
Notes X: Total physical construction cost of standard work Y: Highest standard unit price/m2 Z: Total cost of quality improvement work components			
c.	Physical Construction Cost Analysis		
-	Total Physical Building Cost	:	IDR 6.892.282.152,00
-	Quality Improvement Cost	:	IDR 689.228.215,20
-	Total Cost	:	IDR 7.581.510.367,20
-	11% VAT	:	IDR 833.966.140,39
-	Total Physical Construction Costs + 11% VAT	:	IDR 8.415.476.507,59
-	Rounding*	:	IDR 8.415.480.000,00
1.5	Budget Accuracy Analysis		
-	Budget/Owner HPS	:	IDR 7.410.370.000,00
-	Budget Analysis Results	:	IDR 8.415.480.000,00
-	Budget ceiling difference	:	IDR (1.005.110.000,00)
-	Budget ceiling accuracy value	:	(11,94) %

Source: Research Processing, (2025)

The Willermark and Islind project is the construction of SMPN 14 Bandung, a junior high school located at Jalan Lapangan Supratman No. 8, Bandung Wetan District, Bandung City. This project is part of the educational facility development program funded by the Bandung City Regional Revenue and Expenditure Budget (APBD) for the 2023 fiscal year. This construction work is classified as a non-simple building and is carried out using a unit price contract (build contract) method for 36 days. The

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project owner is the Bandung City Education Office, with the main function of the building being as a place of learning.

a. Budget Ceiling Evaluation

The budget value set (HPS Owner) is IDR 7,410,370,000.00. The contract value agreed upon with the contractor (NKK) is IDR 5,926,650,000.00. After deducting 11% VAT, the NKK value becomes IDR 5,274,718,500.00. The State Building Unit Price (HSBGN) is calculated by dividing the contract value excluding VAT by the building area, resulting in IDR 7,205,899.59 per m².

b. Physical building cost analysis

The physical building cost analysis shows that the standard price (SHST) is IDR 4,847,200.00 per m², while the non-standard price, calculated at a maximum of 150% of the standard price, is IDR 4,120,120.00 per m², resulting in a total physical building cost calculated based on the area and characteristics of the building of IDR 6,892,282,152.00.

c.Non-Standard Price Percentage Analysis

The price percentage analysis for non-standard work was conducted to determine the extent to which the work used technical specifications outside the usual standards. From a total of 16 types of non-standard work analyzed against component X (standard work), a total percentage of 75% was obtained. Thus, the total percentage of non-standard work is 85%, which is still within the maximum limit allowed for educational buildings according to technical regulations.

d. Physical Construction Cost Analysis

Based on the assumption of a 10% increase in quality from the total physical cost, the cost for the quality improvement is IDR 689,228,215.20. After adding Value Added Tax (VAT) of 11% or IDR 833,966,140.39, the total physical construction cost becomes IDR 8,415,480,000.00.

e. Budget Ceiling Accuracy Analysis

Based on the analysis results, the budget ceiling (HPS Owner) is set at IDR 7,410,370,000.00. Therefore, the budget ceiling is set lower than the estimated

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construction cost at the conceptual stage, based on the analysis of standard and non-standard work components.

Next, a multi-criteria analysis was conducted to evaluate the accuracy level of the budget ceiling based on the difference between the cost estimate results at the conceptual stage and the physical budget ceiling value. This analysis was based on the difference between the two values, then referred to the accuracy range that had been determined in previous studies, namely:

Table 3.2 Accuracy Range of Previous Studies

No	Source/Reference	Estimation Method	Accuracy Range
1	Salindeho, B. (2022)	*Cost Significant Model*	–11,794 % s.d +11,433 %
2	Supadi (2023)	*Cost Significant Model*	–4,10 % s.d +6,68 %
3	Peginusa, S. S. (2024)	Parametric	–10,683 % s.d +7,558 %

Source: Research Compilation, (2025)

From these three references, calculations were made to determine the lower and upper limits of accuracy, as a basis for compiling the accuracy assessment interval. In addition, this approach facilitates the development of a classification of cost estimation accuracy, without relying too much on a particular reference.

Therefore, the average lower and upper limits are used as a basis for determining the accuracy assessment interval, which is then used in the preparation of the cost estimation accuracy interval and accuracy categories. The calculation of the average lower limit and average upper limit is as follows:

Average lower limit (Very Inaccurate)

= (–11,794% + (–4,10) % + (–10,683) %) / 3

= –26,577% / 3 = –8,859%

Upper average limit (Less Accurate)

= (+11,433% + 6,68% + 7,558%) / 3

= +25,671% / 3 = +8,557%

This range of values is used as a reference in determining the accuracy interval of cost estimates. The five categories of accuracy intervals for cost estimates are as follows:

Figure 3.1 Cost Estimate Accuracy Interval

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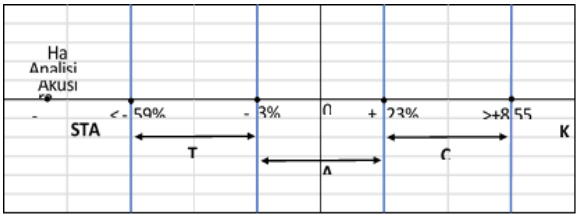

Source: Research Compilation, (2025)

Thus, the budget ceiling accuracy category based on the accuracy category is obtained as follows:

Table 3.3 Accuracy Category

No	Accuracy Category	Value < -8,859%
1	Very Inaccurate	
2	Inaccurate	-8,859% s.d -4,43%
3	Accurate	≥ -4,43% - ≤+4,23%
4	Fairly Accurate	+4,23% - +8,557%
5	L	> + ,

Source: Research Compilation, (2025)

Based on the analysis results showing a difference of -11.94%, this value falls into the "Very Inaccurate" category, as it is below the minimum accuracy threshold obtained from the multi-criteria analysis results.

2. Discussion of Analysis Results Discussion of Analysis Results Evaluation of Cost Estimate Accuracy

Population growth affects the accuracy of conceptual stage cost estimates against physical budget ceilings, which are used to evaluate the extent to which initial estimates reflect actual construction costs. Based on the analysis results, it was found that the percentage of non-standard prices used in preparing the budget ceiling reached 85%. Next, an analysis of the budget ceiling value was conducted to determine the accuracy of the cost estimates. The following are the results of the calculation:

Table 3.4 Discussion of Budget Ceiling Accuracy Value

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	Budget Ceiling Accuracy Value	
No	Description	Value
1.	Budget Ceiling	IDR 7.410.370.000,00
2.	Budget Ceiling Analysis Results	IDR 8.415.480.000,00
3.	Budget Ceiling Difference	(1.005.110.000,00)
4.	Budget Ceiling Accuracy Value	(11,94)%

Source: Analysis Results, (2025)

Based on the table, there is a difference of IDR 1,005,110,000.00 between the estimated construction costs and the budget ceiling, with a deviation rate of 11.94% for the construction project of SMPN 14 Bandung. This negative deviation value indicates that the cost estimate is higher than the predetermined budget ceiling. Therefore, the budget ceiling can be categorized as “not sufficiently accurate” in terms of accuracy.

CONCLUSION

Based on the results of the analysis and discussion in this study, the following conclusions can be drawn regarding the accuracy of the conceptual stage cost estimate for the construction of SMPN 14 Bandung: An evaluation of the budget ceiling for the construction of SMPN 14 Bandung shows a difference of IDR 1,005,110,000.00 or -11.94% between the ceiling value set by the owner and the conceptual stage cost estimate. This negative difference indicates that the estimate is higher than the ceiling value, so that the accuracy of the ceiling is classified as “not accurate enough” based on the accuracy category.

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