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Construction Management Analysis of Cikeruh Steel Box Girder Bridge Project Spanning 80m Cirebon – Bandung Highway Majalengka Regency

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Abstract

This study aims to analyze the construction management of the 80-meter Cikeruh Steel Box Girder Bridge Project on the Cirebon-Bandung Highway in Majalengka Regency, which replaces the old bridge due to structural aging and increased vehicle load intensity. This construction management analysis includes calculating the volume of work, estimating the budget plan (*Rencana Anggaran Biaya* [RAB]), and scheduling project implementation. The research method is qualitative, employing direct observation, interviews, and literature study techniques. The data collected include primary data (field technical data and working drawings) and secondary data (location maps, unit price analysis, and unit prices). The *Analisis Harga Satuan Pekerjaan* (AHSP) used in this study is the 2024 Majalengka Regency AHSP. The results of the main work volume calculations show a bore pile volume of 89.49 m^3, a pile cap volume of 134.4 m^3, a column volume of 50.2656 m^3, and a pier head volume of 56 m^3. Based on the RAB calculations, the total cost required to complete the project is IDR 31,149,328,054.56. The work schedule was analyzed using bar charts and an S-curve. This study provides a comprehensive overview of the essential aspects of volume, cost, and time in bridge construction project management.
Keywords: Construction Management; Bridge; Steel Box Girder; Bar Chart; S-Curve;

INTRODUCTION

Transportation is one of the important aspects for humans in their daily lives. The development of transportation in Indonesia is currently increasing rapidly along with advancements in science and technology in the transportation field. One of the most important components of transportation is the bridge; therefore, effective bridge construction management is needed (Akustia et al., 2024; Lamari et al., 2018; Sidiqah, 2023; Soegoto & Septa, 2018; Styaningsih et al., 2022).

Construction management is the management of planning (work plan), implementation, control, and coordination of a project from the beginning of the work to its completion—effectively and efficiently—to ensure that the project is carried out on time, at the right cost, and with the right quality (Garcés & Peña, 2023; Labaran et al., 2022; Mahmoud al-Mukahal, 2020; Muneer et al., 2022; Walker, 2016).

The Cirebon–Bandung Highway is a provincial road that connects provincial capitals with district/city capitals, between district/city capitals, and serves as a strategic provincial road passed by many vehicles with high intensity. This Cikeruh Bridge has been in place since 1970, where it has undergone many repairs due to the structure's age and damage to some components from the increasing intensity of vehicle loads each year, which could cause collapse if it continues to bear heavy traffic (Amarudin & Kholiq, 2021; Assa Fazri Maulida & Lumban toruan, 2024; Sutanto et al., 2025).

One of the important structural elements in the construction of the Cikeruh Bridge on the Cirebon–Bandung Highway in Majalengka Regency is the steel box girder. As a structural

element that functions as a vehicle load base and connects bridge segments, the steel box girder greatly influences the planning and implementation of bridge construction.

The invention of steel material as a bridge structure has greatly impacted bridge planning and development. Compared to concrete and wood, steel offers advantages such as rust and weathering resistance, ease of cutting to required sizes, and simple assembly and disassembly. A girder bridge features a structure with retaining beams under the vehicle roadway. Several studies on girder bridges have shown that girder structures can bear stronger and stiffer loads due to longitudinal and transverse bracing.

METHODS

The research method used in this study combined qualitative and quantitative approaches. The qualitative method was carried out through direct field observations at the Cikeruh Bridge construction project site in Majalengka Regency, complemented by interviews with related parties, particularly the contractor. Meanwhile, the quantitative method was applied for calculations and analyses related to construction management. The research object focused on the construction management analysis of an 80-meter span bridge with a Steel Box Girder structure. The data used consisted of primary data—obtained from site observations and interviews, including technical field data such as bridge span, pier height, and working drawings—and secondary data sourced from relevant literature, journals, textbooks, and official project documents such as location maps, Unit Price Analysis (AHSP), and material and labor unit prices.

Data collection techniques in this study included field observations to directly examine project conditions, interviews to obtain valid and in-depth information from contractors and related stakeholders, and literature studies to support the theoretical framework and analysis methods. The data analysis method focused on addressing the research problem through calculations of work volume, cost estimation, and project scheduling. Work volume calculations were performed based on working drawings and definitive plans using standard formulas. Cost Budget Planning (RAB) was prepared using the 2024 AHSP of Majalengka Regency, where unit work prices were calculated from the sum of labor, material, and equipment costs multiplied by their respective coefficients, and the total RAB was determined accordingly. Project scheduling analysis was conducted using bar charts to determine activity sequences, start times, and durations, and S-curves to visualize the relationship between implementation time and cumulative cost progress, serving as tools for monitoring and project control.

RESULTS AND DISCUSSION

The results of this study are a detailed analysis of the aspects of work volume, Cost Budget Plan (RAB), and implementation scheduling, which are the basic functions of construction project management.

1. Unit Price Analysis (AHSP)

   The Unit Price Analysis (AHSP) serves as the basis for calculating the unit cost per type of work (Baalousha & Çelik, 2011; Palacios & Angumba, 2021). The AHSP used in this study is the 2024 Majalengka Regency AHSP. The unit price of work is influenced by

three main components, namely labor wages, material/material prices, and equipment costs.

The scheme for calculating the unit price of work is as follows:

Unit Price of Work = Wages + Materials + Equipment

Table 1. Unit Price of Wages

No	WAGE DESCRIPTION	UNIT	UNIT PRICE	
			MINUMUM (Rp)	MAXIMUM (Rp)
1	Leader	Day/Person	150.000,00	155.000,00
2	Skilled drivers	Day/Person	150.000,00	200.000,00
3	Driver Assistant	Day/Person	100.000,00	150.000,00
4	Skilled Operators	Day/Person	200.000,00	250.000,00
5	Assistant Operator	Day/Person	100.000,00	150.000,00
6	Labourers/Skilled Workers	Day/Person	90.000,00	110.000,00
7	Head Builder	Day/Person	130.000,00	140.000,00
8	Skilled Craftsman	Day/Person	125.000,00	135.000,00
9	Skilled Builder	Day/Person	80.000,00	100.000,00
10	Past Daily Workers	Day/Person	85.000,00	95.000,00
11	Electrician Hire	Day/Person	150.000,00	175.000,00
12	Electricians	Day/Person	120.000,00	140.000,00

Table 2. Unit Price of Materials

No	Ingredients	Units	Pricing
1	Concrete K-250 Readmix	M3	Rp.1.041.900,00
2	Concrete Borepile K-250 readymix	M3	Rp.1.641.752.00
3	Concrete k-350 readymix	M3	IDR 1,889,715,00
4	Concrete k-100readymix	M3	IDR 1,775,873,00
5	Asphalt Concrete wearing coast	M3	Rp.1.220,000.00
6	PCI Girder Type I=21	Fruit	Rp.106.7000,00
7	PCI Girder Type I=21	Fruit	Rp.106.7000,00
8	PCI Girder Type I=21	Fruit	Rp.106.7000,00
9	PCI Girder Type I=21	Fruit	Rp.106.7000,00
10	PCI Girder Type I=21	Fruit	Rp.106.7000,00
11	PCI Girder Type I=21	Fruit	Rp.106.7000,00
12	PC Box Girder L=6,8m H=2,7m	Fruit	Rp.30.000.000.00
13	PC Box Girder L=6,8m H=2,7m	Fruit	Rp.30.000.000.00
14	PC Box Girder L=6,8m H=2,7m	Fruit	Rp.30.000.000.00
15	Tack Coat/Emulsion	M2	IDR13,530.00
16	Iron D13	KG	Rp.9.000,00
17	Iron D125	KG	Rp.9.100,00
18	Iron D16	KG	Rp.9.000,00
19	Iron D32	KG	IDR 9,150.00
20	Iron D25	KG	Rp.9.100,00
21	Iron D32	KG	IDR 9,150.00
22	Pop	KG	IDR 22,000.00
23	Mould Oil	Ltr	Rp.7.500,00

Table 3. Unit Tool Price

No	Tools	SATUAN	PRICING
1	Dump truck	Units	436.957
2	Bulldoze	Units	687.499
3	Vibrator plate tamper	Units	50.268
4	Asphalt mixing plant	Units	4.930.000
5	Aspalt finisher	Units	740.000
6	Wheel loaders	Units	574.000
7	Concrete vibrator	Units	48.000
8	Concrete pump	Units	448.370
9	Bar cutter and barbender (reinforcement)	Units	146.300
10	Bore pile machine	Units	1.309.228
11	Tandem rollers	Units	507.638
12	Crawler crane 80 ton	Units	700.000
13	Excavator	Units	873.000
14	P.type rollers	Units	501.930
15	Stressing jack	Units	335.274
16	Generator	Units	370.071

Each component is obtained from the multiplication of the price of the basic unit by its analysis coefficient. The quality and accuracy of RAB is highly dependent on the accuracy of determining the material coefficient, the level of labor productivity, and the efficiency of using heavy equipment in the field.

2. Calculation of Work Volume and RAB

The calculation of the volume of work is an essential stage in project planning to know the amount of cost required. The results of the volume calculation for the main structure work of the Cikeruh Bridge are as follows:

Bore Pile Foundation Volume : 89.49 m3

Volume Battery Cap : 134.4 m3

Column Volume : 50,2656 m3

Volume Pier Head : 56.000 m3

This total volume is then used as a substitute for the Unit Price of Work to obtain the Cost Budget Plan (RAB). The RAB is an important document that serves as a reference for payment applications and a framework for calculating the total cost of the project.

Cost Budget Plan (RAB) for the Cikeruh Bridge Project.

Based on the analysis of the total volume and unit price, the total cost needed to complete the construction of the Cikeruh Bridge is IDR 31.149.328.054,56. This cost covers all components from preparatory work to finishing work (asphalt).

Cost Discussion:

The size of the construction project budget is greatly influenced by geographical factors, the availability of natural resources, and differences in material prices and labor wages between regions. The use of high-quality concrete (fc30MPa) in the abutments, pile caps, and floor plates, as well as the use of Steel Box Girder steel structures as the top building, reflect the need for structural strength and long plan life, thus correlating directly with the high calculated RAB value.

Table 5. Cost Budget Plan

No	JOB DESCRIPTION	Volume of Work			
		Volume	Units	Unit Price	Quantity
1	**PREPATION**				
a	Land Cleaning	1	Is	IDR 23,740,000.00	IDR 23,740,000.00
b	Office	1	Is	IDR 444,000.00	IDR 444,000.00
c	Mob Girder	1	Is	IDR 53,880,000.00	IDR 53,880,000.00
2	**BOTTOM SRUCTURE**				
a	Bore Pile	454	Fruit	IDR 23,700.00	IDR 106,944,161.00
b	Lean Concrete	23	m3	IDR 1,507,500.00	IDR 34,491,600.00
c	Abutment A1	46	m3	IDR 1,241,200.00	IDR 56,994,166.32
d	Pier P1	1537	m3	IDR 19,488,000.00	IDR 29,960,581,875.84
e	Abutment A2	61	m3	IDR 1,241,200.00	IDR 75,593,424.20
f	Structural Translation Slab	40	m3	IDR 1,085,400.00	IDR 43,763,328.00
3	**UPPER STRUCTURE**				
a	Steel Box Girder	15	Fruit	IDR 1,085,400.00	IDR 16,281,000.00
b	Concrete	275	m3	IDR 1,085,400.00	IDR 298,465,896,00
4	**FINISHING**				
a	Parapet	208	Unit	IDR 1,000,000.00	IDR 208,000,000.00
b	Asphalt (t=50cm)	52	m3	IDR 5,223,000.00	IDR 270,148,602.24
					IDR 31,149,328,054.56

3. Bar Chart Analysis

A Bar Chart is a chart that simply shows the information of a project's schedule, start time, finish time, and duration of each activity. These diagrams are easy to read and are often used as a work plan (Alexiou & Bourbakis, 2023). The Bar Chart on the Cikeruh Bridge project is used to determine the order of work and detail the time allocation for human resources (workers), heavy equipment, and materials during the implementation period.

4. S-Curve Analysis

The S-curve is the most popular time control and planning tool, describing the relationship between the project execution time and the accumulated value of progress (weight) that has been achieved.

S-Curve Function: In addition to being a schedule, the S-Curve serves as a project financial guideline, shows work on critical trajectories, and is a material for reporting progress to the owner or consultant.

Weight Calculation: The weight of the work is obtained by dividing the cost of the work per item by the total cost budget of the project. An example of a weight calculation in Week 1 is:

Cost = Materials + Tools + Workers = IDR 0.00 + IDR 2,100,000.00 + IDR 1,800,000 = IDR 3,900,000.00

Weight 1st Week = $\frac{Rp\ 20.940.000{,}00}{Project\ Fee\ Total}\ x\ 100\%$ = 31.9%

Scheduling Discussion:

The typical S-curve shows small progress at the beginning (preparation and foundation stages—the bore pile is a critical trajectory), then increases rapidly in the core

phase (structure), and slopes back down again in the final phase (finishing). The advantage of the S-curve is that it is able to monitor deviations from the plan, although the disadvantage is that it only displays the accumulated costs without explicitly showing the relationship of dependency between jobs, which can be better handled with other methods such as CPM (although CPM is not analyzed in depth in this report). Overall, this construction management analysis successfully presented detailed time and cost estimates, providing a solid framework for the control of Triple Constraint (Time, Cost, Quality) during the implementation of the Cikeruh Bridge Project.

	Material	Alat	Pekerja	Total	kum
	p	Rp	Rp	Rp	0
Week 1	-	2.100.000	1.800.000	3.900.000	3.900.000
week 2			3.600.000	3.600.000	7.500.000
week 3			1.500.000	1.500.000	9.000.000
week 4		900.000	3.000.000	3.900.000	12.900.000
week 5		900.000	6.000.000	6.900.000	19.800.000
week 6	44.483.460	900.000	6.300.000	51.683.460	71.483.460
week 7	29.680.253		7.500.000	37.180.253	108.663.713
week 8			8.400.000	8.400.000	117.063.713
week 9		106.026.000	18.300.000	124.326.000	241.389.713
week 10	69.603		5.700.000	5.769.603	247.159.317
week 11			35.400.000	35.400.000	282.559.317
week 12	64.501.753	150.126.000	24.900.000	239.527.753	522.087.070
week 13	22.400.000	30.126.000	49.500.000	102.026.000	624.113.070
week 14	89.150.208		18.000.000	107.150.208	731.263.278
week 15			23.400.000	23.400.000	754.663.278
week 16	16.878.577	180.252.000	26.400.000	223.530.577	978.193.855
week 17	34.821.500		8.100.000	42.921.500	1.021.115.355
week 18	22.400.000		46.200.000	68.600.000	1.089.715.355
week 19	89.150.208		48.000.000	137.150.208	1.226.865.563
week 20			24.000.000	24.000.000	1.250.865.563
week 21	145.856.013	15.000.000	39.000.000	199.856.013	1.450.721.577
week 22		75.000.000	600.000	75.600.000	1.526.321.577
week 23	89.150.208		5.700.000	94.850.208	1.621.171.785
week 24	23.879.520.000		7.200.000	23.886.720.000	25.507.891.785
week 25		30.000.000	18.000.000	48.000.000	25.555.891.785
week 26	34.821.500	300.000.000	18.300.000	353.121.500	25.909.013.285
week 27	2.065.280		11.100.000	13.165.280	25.922.178.565
week 28	66.862.656		11.100.000	77.962.656	26.000.141.221
week 29	12.783.169		9.000.000	21.783.169	26.021.924.390
week 30	12.783.169	510.000.000	24.600.000	547.383.169	26.569.307.559
week 31				-	26.569.307.559
week 32	1.953.095.991		5.700.000	1.958.795.991	28.528.103.550
week 33			7.200.000	7.200.000	28.535.303.550
week 34	28.269.879	285.000.000	21.300.000	334.569.879	28.869.873.429
week 35			7.200.000	7.200.000	28.877.073.429
week 36	28.269.879		21.300.000	49.569.879	28.926.643.308
week 37				-	28.926.643.308
week 38	5.427.000	5.100.000	15.300.000	25.827.000	28.952.470.308
week 39	58.045.493	22.500.000	22.500.000	103.045.493	29.055.515.801
week 40	3.822.560	13.500.000	145.500.000	162.822.560	29.218.338.361
week 41	34.584.709	24.000.000	145.500.000	204.084.709	29.422.423.070
week 42	171.606.167	1.350.000.000	24.000.000	1.545.606.167	30.968.029.236
week 43	10.370.080	13.500.000	13.500.000	37.370.080	31.005.399.316
week 44	68.144.190	20.700.000	20.700.000	109.544.190	31.114.943.507
week 45		5.100.000	4.500.000	9.600.000	31.124.543.507
week 46				-	31.124.543.507
week 47	13.499.672	4.932.000	6.000.000	24.431.672	31.148.975.178
week 48				-	31.148.975.178
Jumlah	27.032.513.178	3.145.662.000	970.800.000	31.148.975.178	

Fig 1. S-Curve Recapitulation

CONCLUSION

The analysis of construction volume and cost budgeting for the 80 m span Cikeruh Steel Box Girder Bridge project on the Cirebon–Bandung Highway in Majalengka Regency revealed structural volumes including bore pile (boron stack) at 89.49 m^3, pile cap (battery cap) at 134.4 m^3, column at 50.2656 m^3, and pier head at 56.000 m^3, with a total Cost Budget Plan (RAB) of IDR 31,149,328,054.56 covering items such as land clearing (IDR 23,740,000), Pier P1 construction (IDR 29,960,581,875.84), concrete deck slab (IDR 298,465,896.96), and asphalt pavement (IDR 270,148,602.24). Materials used encompassed various K-250 to K-350 ready-mix concretes, asphalt concrete wearing course, PCI Type L = 21, PC Box Girder (L = 6.8 m, H = 2.7 m), tack coat, reinforcing steel (D13–D32), formwork nails, and oil, while main equipment included dump trucks, bulldozers, excavators, crawler cranes, bore pile machines, concrete pumps, and generators to ensure effective execution. For future research, it is recommended to incorporate advanced simulation tools like Building Information Modeling (BIM) or finite element analysis to optimize material usage, predict long-term structural durability under varying traffic loads, and compare costs against sustainable alternatives such as high-performance steel alloys.

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