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Cost and Time Efficiency of Reinforced-Concrete Column Construction Using Conventional and Ready-Mix Methods: A Case Study of the Nurul Yaqin Mosque Project in Bumi Pajo Village

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A B S T R A C T

This study compares the cost and time efficiency of conventional and ready-mix methods for reinforced-concrete column work in the Nurul Yaqin Mosque project, Bumi Pajo Village. Work volumes, unit prices, project cost estimates, and construction schedules were analyzed using field observations, literature, and project documentation. Conventional concrete had a unit price of IDR 1,238,000/m³, compared with IDR 1,514,506/m³ for ready-mixed concrete. Total costs were IDR 136,562,428 and IDR 141,276,996, respectively. The conventional method required 9 days, whereas ready-mix construction required 7 days. Ready-mix costs were increased by mixer-truck transportation, equipment operation, and restricted uphill access approximately 7 km from the national highway. Batching-plant production, however, shortened the placement duration. The conventional method was therefore more cost-efficient, while ready-mixed concrete was more time-efficient. Method selection should account for project accessibility, schedule requirements, quality control, and budget constraints.

INTRODUCTION

Construction continues to evolve in both design and implementation methods. Different construction methods yield different productivity levels and consequently affect project duration and cost; implementation must therefore be managed efficiently (Sastra Wibawa, Angga Diputera, and Candra Devi 2026). Infrastructure construction methods range from conventional on-site practices to precast concrete systems in which components are installed at the project site (Andriawan and Tan 2021).

Concrete is a fundamental material in roads, bridges, buildings, and other infrastructure. Advances in reinforced-concrete technology have produced several implementation methods, including site-mixed, ready-mixed, and precast concrete. Each method entails different costs and construction durations (Atika et al. 2021).

Site-mixed and ready-mixed concrete differ principally in their production processes. Conventional or site-mixed concrete is cast in place using previously installed formwork and is mixed manually or with an on-site mixer (Fatoni, Huda, and Priyoto 2024). Ready-mixed concrete is produced using computer-controlled equipment at a batching plant and subsequently transported to the project site (Nasir, Tuloli, and Alitu 2022).

Previous studies have compared the efficiency of concrete-production methods. Sastra Wibawa, Angga Diputera, and Candra Devi (2026), for example, reported that conventional construction cost IDR 158,728,450 and required 8 days, whereas ready-mixed concrete cost IDR 186,606,936 but required only 1 day. Ready-mixed concrete was IDR 27,878,486, or

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approximately 17.6%, more expensive, while reducing the construction period by 7 days. The conventional method was therefore more economical, whereas the ready-mix method was substantially more time-efficient.

The relative efficiency of concrete methods nevertheless varies among projects. Cost and time performance are affected by site conditions, work volume, material-distribution access, and labor requirements. Moreover, earlier studies have predominantly examined floor slabs and multi-storey buildings; evidence concerning reinforced-concrete columns in religious-building projects remains limited.

The Nurul Yaqin Mosque project in Bumi Pajo Village uses reinforced-concrete columns as principal structural elements. Its considerable distance from the batching plant is an important factor in determining the most efficient concrete method. A comparison of conventional and ready-mix construction is therefore required to identify the method that provides the most suitable cost and time performance under the project conditions.

This study compares the cost and time efficiency of conventional and ready-mix methods for reinforced-concrete column construction in the Nurul Yaqin Mosque project, Bumi Pajo Village. The findings are expected to inform the selection of a concrete method that is efficient and appropriate for the conditions of the project.

RESEARCH METHODS

This quantitative study employed a comparative analytical approach to evaluate the cost and time efficiency of conventional and ready-mix methods for reinforced-concrete column work. The analysis used numerical calculations based on work volume, unit prices, and construction duration. Quantitative research evaluates relationships among variables using numerical data processed through statistical or technical calculations (Sugiyono 2019).

The study was conducted at the Nurul Yaqin Mosque construction project in Bumi Pajo Village, approximately 7 km from the national highway. Access to the site consists of relatively narrow village roads with several steep sections. These conditions were considered when evaluating material distribution and the mobilization of ready-mix concrete.

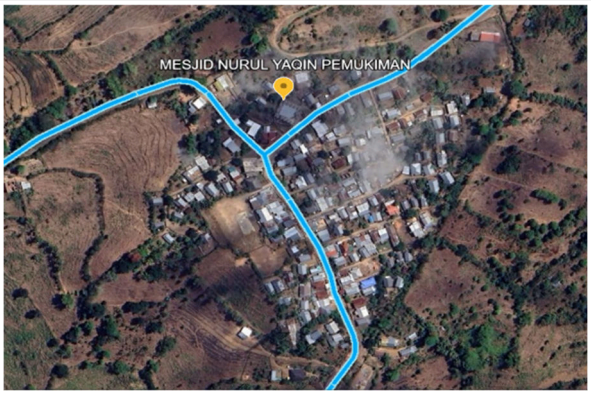


Figure 1. Location of the Study Area

The study used primary and secondary data. Primary data were obtained through field observations and direct calculations of reinforced-concrete column work, including column dimensions and quantities, material and labor requirements, and estimated construction duration. Secondary data comprised Indonesian National Standards (SNI), the Work Unit Price Analysis (AHSP), material-price and labor-wage schedules, and relevant civil-engineering literature.

Data were collected through field observation, literature review, and project documentation. Field observations documented site conditions and accessibility. The literature review covered scholarly articles, construction standards, and civil-engineering textbooks supporting the analytical framework. Project documents provided technical data for work-volume calculations and preparation of the cost estimate. These procedures were intended to provide sufficiently complete and reliable data for the analysis.



Figure 2. Condition of Reinforced-Concrete column work at the Nurul Yaqin Mosque

Data analysis comprised several stages. First, the volume of reinforced-concrete column work was calculated from the dimensions and number of columns. Work Unit Price Analyses were then prepared for each method using the corresponding material, labor, and equipment requirements. Project cost estimates were subsequently developed for both the conventional and ready-mix methods. Finally, implementation schedules were prepared to estimate the duration of each method.

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The total cost and construction duration of the two methods were compared to determine the method most efficient under the specific conditions of the Nurul Yaqin Mosque project.

Literature review

Reinforced concrete combines concrete and reinforcing steel to resist structural loads. Because concrete work is labor- and resource-intensive, selecting an appropriate implementation method can optimize quality, time, and cost (Ngurah Angga, 2022). Concrete provides high compressive strength but limited tensile resistance; steel reinforcement improves its tensile and flexural capacity. Mulyono (2004) defines concrete as a mixture of Portland cement, fine aggregate, coarse aggregate, water, and, where required, admixtures that hardens through hydration. Its advantages include high compressive strength, formability, weather resistance, and relatively low maintenance requirements.

The conventional method produces concrete directly on-site using equipment such as a concrete mixer. Material measurement, mixing, transportation, and placement are performed within the project area. This method is common in small-to-medium projects because it is flexible and independent of batching-plant deliveries. Its limitations include longer duration, greater labor demand, and potentially less consistent concrete quality.

Ready-mixed concrete is produced at a batching plant according to a specified mix design and delivered by mixer truck. Controlled production improves consistency and permits faster placement with reduced on-site labor. Additional transportation and equipment costs are nevertheless incurred. The accessibility of the site and its distance from the batching plant therefore materially affect cost and time efficiency.

Cost and time efficiency are key indicators of construction-project performance. Along with quality, they form the project-management triple constraint (Soeharto 1999). Cost concerns delivery within budget, time concerns completion within schedule, and quality concerns compliance with technical specifications.

A Work Unit Price Analysis (AHS) estimates the labor, material, and equipment costs required to complete one unit of construction work and provides the basis for a project cost estimate. For reinforced-concrete work, the AHS includes concrete materials, reinforcement, formwork, labor, and equipment. In this study, it was used to compare column-work costs under the conventional and ready-mix methods.

A Work Unit Price Analysis provides the cost basis for preparing a construction-project budget.

A construction schedule defines the sequence and duration of project activities. In this study, schedules based on field productivity and work sequences were used to compare the duration of reinforced-concrete column construction under the two methods.

RESULTS AND DISCUSSION

Calculations of work volume, unit prices, project costs, and schedules produced the principal findings concerning the cost and time efficiency of conventional and ready-mix methods for reinforced-concrete columns in the Nurul Yaqin Mosque project.

a. The total concrete volume was 15.36 m^3 for 32 columns measuring 40 × 40 cm. Reinforcement requirements totaled 1,171 kg and formwork requirements totaled 153.6 m^2. These quantities formed the basis for the Work Unit Price Analysis, project cost estimate, and construction schedule.

b. The Work Unit Price Analysis incorporated the materials, labor, and equipment required for each method. Conventional construction involved on-site mixing, reinforcement, formwork, placement, and curing. Ready-mix construction incurred additional mixer-truck transportation and placement-equipment costs. These differences provided the basis for evaluating the relative cost efficiency of the methods.

Table 1. Comparison of unit prices for column work (IDR/m^3)

Work item	Conventional method	Ready-mix method
Concrete column (/m^3)	IDR 1,238,000	IDR 1,514,506
Equipment (/kg)	IDR 38,475	IDR 38,475
Formwork (/m^2)	IDR 384,100	IDR 384,100

Based on the analysis of Unit Work Prices (AHS), it is evident that the ready-mix method entails a higher unit cost for concrete work compared to the conventional method. This cost difference is primarily driven by additional components, specifically transportation costs using mixer trucks and the operational costs of equipment required for the ready-mix execution process. Consequently, the cost structure of the ready-mix method reflects additional expenses relative to the conventional method, making this a crucial factor when considering cost efficiency in construction projects.

c. Project Cost Estimate for the Conventional Method
Based on the prepared Budget Plan (RAB), the reinforced concrete column work using the conventional method results in a total cost of Rp136,562,428. This cost comprises column formwork, reinforcement, and concreting operations.

Table 2. Cost Estimate for Conventional Reinforced-Concrete column work

CONSTRUCTION WORKER EXPENSES USING THE CONVENTIONAL METHOD					
No.	WORK DESCRIPTION	VOLUME	UNIT	UNIT PRICE (RP)	TOTAL PRICE (RP)
1	2	3	4	5	6
A	REINFORCED CONCRETE COLUMN (40 x 40 cm)	153.6	M2	384,100	58,997,760
B	BUILDING INSTALLATION WORK (INCLUDING LABOR)	1,170	kg	38,475	45,015,750
C	CONCRETE WORK	15	M3	1,238,000	19,015,680
			Direct Cost		123,029,190.00
			PPN (11% × a)		13,533,238
			Total Amount		136,562,428.00

d. Project Cost Estimate for the Ready-Mix Method

The preparation of the Budget Plan (RAB) using the ready-mix method indicates a total project cost of Rp141,276,996. This cost comprises ready-mix concrete work, column reinforcement, and column formwork.

Table 3. Cost Estimate for Ready-Mix Reinforced-Concrete column work

COLUMN WORK USING READY-MIX METHOD					
No.	WORK DESCRIPTION	VOLUME	UNIT	UNIT PRICE (IDR)	TOTAL PRICE (IDR)
1	2	3	4	5	6
A	Ready-Mix Concrete Work K-250	15.36	M3	1,514,506	23,262,813
B	Column Reinforcement Work	1,170	Kg	38,475	45,015,750
C	Column Formwork	153.6	M^2	384,100	58,997,760
			Real Cost		127,276,573
			VAT (11% × a)		14,000,423
			Grand Total		141,276,996

e. Time schedule

The scheduling analysis indicates that the ready-mix method entails a shorter work duration compared to the conventional method. This efficiency arises because the concrete mixing process for the ready-mix method takes place at a batching plant, allowing on-site pouring operations to proceed more rapidly and in a more organized manner.

Table 4. Schedule for Conventional Reinforced-Concrete Work

No.	JOB DESCRIPTION	TOTAL PRICE RP	Weight (%)	DURATION	DAY 1	2	3	4	5	6	7	8	9
B	COLUM CLEANING WORK	45.015.750	36,59	4	9,15	9,15							
A	COLUMN FORMWORK 40 X40 CM	58.997.760	47,95	5			9,59	9,59	9,59		9,59		
C	COLUMN CONCRETE WORK	19.015.680,00	15,46	3							5,15	5,15	5,15
	TOTAL	123.029.190,00	100,00		9,15	9,15	18,74	18,74	9,59	9,59	14,74	5,15	5,15
	CUMULATIVE TOTAL				9,15	18,29	37,03	55,77	65,36	74,95	89,70	94,85	100,00

Discussion

a. Cost Comparison

The conventional method cost IDR 136,562,428, whereas the ready-mix method cost IDR 141,276,996. The higher ready-mix cost resulted primarily from mixer-truck transportation, equipment operation, and concrete-vibrator use. Conventional concrete was mixed on site and therefore did not incur batching-plant distribution costs.

The project site is approximately 7 km from the national highway and is reached by an uphill access road, increasing ready-mix mobilization and delivery costs.

Although ready-mixed concrete was more expensive, it provided more consistent quality, faster placement, and reduced on-site mixing. Reinforcement and formwork costs did not differ materially because column dimensions, reinforcement requirements, and the formwork system were identical. The cost difference was therefore primarily attributable to concrete production and placement.

b. Time Comparison

The conventional method required 9 days, whereas the ready-mix method required 7 days. Ready-mixed concrete arrived ready for placement, while conventional concrete required sequential on-site batching. Ready-mix productivity nevertheless remained sensitive to mixer-truck access along the steep village road.

c. Efficiency of the Construction Methods

Each method presented distinct advantages and limitations. Conventional concrete was more economical because it avoided delivery and specialized-equipment costs, making it suitable for budget-constrained or difficult-to-access projects. Ready-mixed concrete provided shorter duration and more consistent production quality, making it suitable for projects requiring rapid implementation and tighter quality control. Selection should therefore consider site conditions, schedule requirements, cost, and material-distribution accessibility.

CONCLUSION

The following conclusions were derived from the comparison of conventional and ready-mix concrete methods for the Nurul Yaqin Mosque project: (1) The unit price was IDR 1,238,000/m^3 for conventional concrete and IDR 1,514,506/m^3 for ready-mixed concrete. Transportation, equipment operation, and concrete-vibrator use increased the ready-mix cost; (2) The total project cost was IDR 136,562,428 for the conventional method and IDR 141,276,996 for the ready-mix method. Conventional concrete was more economical, partly because the site lies approximately 7 km from the national highway along an uphill access road; (3) The conventional method required 9 days, whereas the ready-mix method required 7 days because batching-plant production accelerated on-site placement; (4) Reinforcement and formwork did not differ materially between the methods because the same column dimensions, reinforcement quantities, and formwork system were used; (5) Overall, the conventional method was more cost-efficient, whereas ready-mixed concrete was more time-efficient. Method selection should reflect site accessibility, material distribution, schedule requirements, and budget capacity.

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