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Analysis of Time and Cost Efficiency through the Application of Design Review on the Bridge Rehabilitation Project in Bantuas Village, Samarinda City

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Abstract; The application of review design in construction projects serves as an effective strategy to enhance implementation efficiency. This study aims to analyze time and cost efficiency resulting from the application of review design in the Bantuas Bridge rehabilitation project in Samarinda City. The research employs a comparative analysis between the initial design and the revised design, evaluating construction methods, equipment productivity, activity duration, and cost requirements. Data were collected from planning documents, cost estimates, technical reports, and field observations. The results indicate that the review design reduced project duration from 150 to 140 days, achieving a time efficiency of 6.67%. Additionally, the total project cost decreased from Rp3,000,487,000 to Rp2,860,487,000, resulting in a cost saving of 4.67%. These efficiencies were achieved through the adoption of precast minipile foundations and modular structural components such as steel decks. Therefore, the review design is proven to be an effective strategy for improving construction efficiency in terms of time and cost.

Keywords: Review design, time efficiency, cost efficiency, bridge rehabilitation, construction methods

INTRODUCTION

The construction and rehabilitation of bridge infrastructure requires accurate planning to ensure effective and efficient project completion [Andayani & Lestari, 2021]. In Bantuas Village, Samarinda City, a bridge serving as a major hub for community activities is showing signs of structural deterioration due to its long service life, high daily traffic loads, and environmental influences such as humidity and potential local flooding. These conditions make the bridge vulnerable to functional failure and potential safety risks for road users.

In an effort to improve rehabilitation effectiveness, the concept of design review is increasingly being applied to reassess potentially suboptimal initial designs [Nasution & Pratama, 2022]. Design reviews provide planners with the opportunity to propose changes to implementation methods, improve material specifications, and adjust work volumes to achieve time and cost efficiencies without compromising structural safety. Design alternatives such as changing foundation methods, using precast elements, or selecting more durable materials are becoming a primary focus in cost-saving efforts [Putra & Hadi, 2020; Subagyo, 2019].

In the Bantuas bridge rehabilitation, the implementation of design review is believed to provide significant benefits in terms of both accelerated implementation and cost reduction. However, the extent to which these efficiencies are achieved still needs to be analyzed based on technical data, budget documents, and field construction evaluation results [Siringoringo, 2021]. Therefore, this study aims to conduct a comprehensive analysis of the impact of design review on reducing project duration and costs, thereby providing a scientific basis for planning decisions on future bridge rehabilitation projects.

RESEARCH METHOD

Types of research

This research uses a quantitative-comparative method, with an analysis focus on measuring time and cost efficiency after a design review.

Data and Data Sources

- Primary Data:
    - Field observation
    - Technical consultation with project engineers
    - Daily/weekly progress notes
- Secondary Data:
    - Initial design plan
    - Design review
    - Detailed Budget Plan
    - Project implementation schedule
    - Estimation of productivity and work methods

Data Collection Technique

1. Collection Of Contract and Design Documents
2. Collecting Data on Work Volume and Costs
3. Recapitulation of Activity Duration Based on the S-Curve
4. Identify The Differences in Construction Methods
5. Supporting regulatory studies (PUPR Ministerial Regulation and SNI)

Variables Analysed

- Time Variable: Total duration of work before and after review
- Cost Variables: Total construction cost based on design change items
- Construction Method Variables: Changes in technology and materials that affect productivity

Data Analysis Techniques

1. Time Difference Analysis:
    - Initial duration vs duration after review
    - Time efficiency calculation (%)
    - Impact of changes in implementation methods
2. Cost Difference Analysis:
    - Cost Difference Analysis
    - Identify jobs that cause savings
    - Calculation of cost efficiency (Rp and %)

3. Constructability Analysis:
    - Assess the ease of implementation of new methods
    - Assess potential risk reduction for delays
4. Project Efficiency Analysis; Combining time and cost efficiency to determine the level of effectiveness of design reviews.

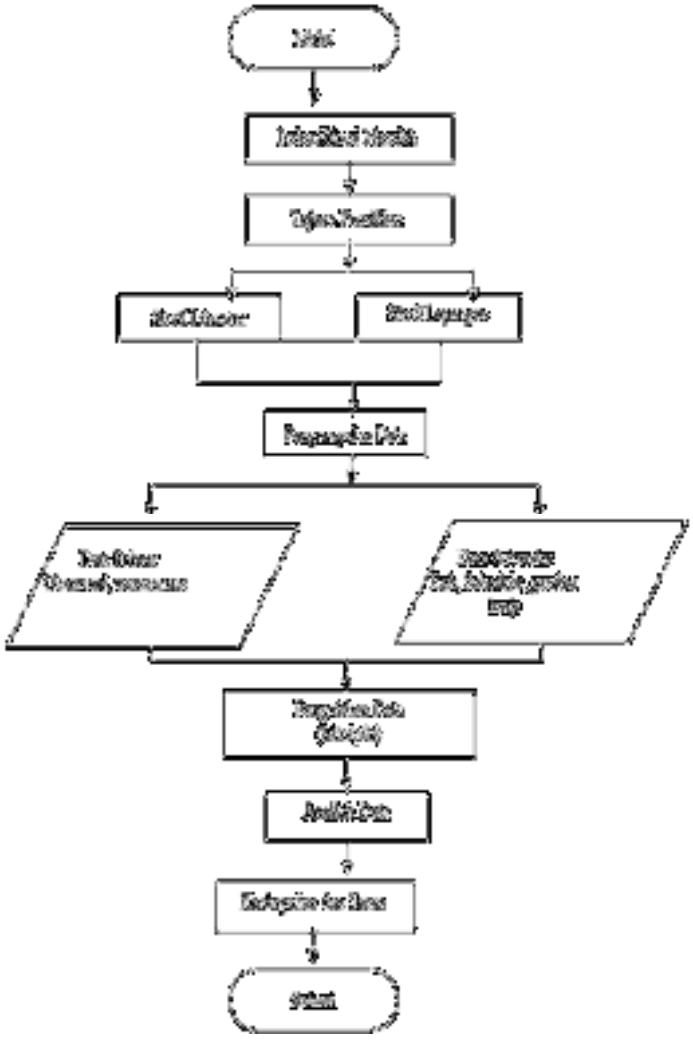

Figure 1. Research flow chart

RESULTS AND DISCUSSION

Overview of the Bantuas Bridge Rehabilitation Project

The bridge rehabilitation project in Bantuas Village is part of the local government's efforts to improve inter-regional connectivity. The structure's functional and structural damage necessitated design updates to adapt to field conditions. Key issues identified included damage to the floor slab, deformation of secondary structural elements, and the risk of foundation stability degradation.

Identifying Problems and Needs for Design Review

Based on the initial evaluation, several challenges were identified in the first design, such as inefficient construction methods, the use of materials requiring long curing times, and high heavy equipment operating costs. A design review was conducted to develop alternative designs that were more efficient in terms of time and cost.

The Influence of Design Review on Accelerating Implementation Time

The analysis showed that the design review resulted in significant changes to the work schedule. The initial duration of 150 days was revised to 140 days, resulting in a 10-day (6.67%) improvement. The acceleration was due to:

- Application of the minipile foundation method which is faster to install than bore piles.
- Use of modular steel decks which do not require concrete hardening time.
- Changes to a more effective workflow strategy.

This time acceleration has an impact on the efficiency of heavy equipment use, reduced overtime costs, and reduced risk of weather disruptions.

Cost Change Analysis and Sources of Savings

A comparison of the Budget Plan shows a cost reduction from Rp3,000,487,000 to Rp2,860,487,000, representing an efficiency of 4.67%. The savings come primarily from:

- Reduced foundation drilling work.
- Reduction of high-cost heavy equipment working hours.
- Reduction in the number of workers for concrete work.
- Reduction in the cost of additional materials (curing agent, formwork, etc.).

Although some materials in the new design have a higher unit price, overall costs remain lower because the implementation method is much more efficient.

Risk Analysis and Its Impact on Time and Cost Efficiency

Design reviews also contribute to reducing implementation risks. Risks that have been successfully minimized include:

- Risk of delays due to weather, as concrete work is reduced.
- Risk of foundation damage due to inconsistent quality of precast piles.
- Risk of cost overruns from additional work on the initial design.

More effective risk management contributes directly to time efficiency and cost savings.

Design reviews provide a number of technical advantages that impact efficiency:

- Modularity of structural elements allows for faster installation and higher precision.
- Material quality is increased without significantly increasing costs.
- Reducing the volume of wet work speeds up the workflow.

Overall, design review proved to be a strategic approach to improving construction efficiency in bridge rehabilitation projects.

CONCLUSION

Based on the results of research and analysis on the effectiveness of implementing design reviews on the rehabilitation work of Bantuas Bridge, Palaran District, it can be concluded that the design review process has a significant impact on improving project performance in terms of time, cost, and quality.

Time Aspect

The implementation of changes in construction methods—specifically, replacing bored pile foundations with precast minipile piles and using a modular steel deck—reduced the total construction duration from 150 days to 140. This 6.67% time efficiency demonstrates that selecting the right construction method directly impacts project acceleration and reduces the risk of delays.

Cost Aspect

The design review resulted in a reduction in project costs from Rp3,000,487,000 to Rp2,860,487,000. Savings of Rp140,000,000 (4.67%) were achieved through reduced drilling, efficient use of heavy equipment, and reduced labour requirements for concrete work. The design changes proved effective in reducing costs without compromising construction quality.

Quality Aspects

Structural quality has been improved through the use of 30 MPa fc' concrete, precast foundations, and steel structural elements such as steel decks and galvanized railings. Materials with higher technical standards provide better structural reliability, increased corrosion resistance, and extended the bridge's service life.

Overall, design reviews have proven to be an effective approach in improving the efficiency of bridge rehabilitation projects, while ensuring better and more sustainable construction quality. The implementation of design reviews is highly recommended as part of value engineering management for similar infrastructure projects.

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