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Productivity Analysis Of Lightweight Concrete Block Wall Installation Using Time Study Method On Building X Project In Tasikmalaya

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ABSTRACT

Labor productivity strongly impacts construction time and cost. While standard metrics like the PUPR Work Unit Price Analysis (AHSP) are widely used, actual field productivity often deviates due to specific site conditions and labor dynamics. This discrepancy necessitates localized empirical evaluation. Thus, this study analyzes lightweight concrete block wall installation productivity at Building X Project, Tasikmalaya, using the time study method. Field observations over three days involved one crew (one mason, two helpers). Data were collected using stopwatches and video recordings. The results showed that the average actual field productivity reached 12.20 m²/day, significantly surpassing the national AHSP standard of 7.69 m²/day, demonstrating that job-site performance can substantially exceed established national theoretical productivity benchmarks. Field labor coefficients were highly efficient at 0.082 OH/m² (mason) and 0.164 OH/m² (helpers). Time allocation analysis showed that the mason focused primarily on productive installation activities, while the two helpers exclusively performed supporting tasks such as material transport, block cutting, and mortar mixing, thereby maximizing overall work efficiency. These findings demonstrate that an efficient labor composition and clear task division can substantially improve productivity beyond applicable AHSP standards.

1. Introduction

Labour productivity is a critical determinant of construction project performance because it directly influences the efficiency of labour, time, and cost utilization [1]. As construction activities rely heavily on labour-intensive processes, variations in worker productivity can substantially affect the quantity of work completed within a given period and, consequently, the overall project duration and cost [2], [3]. Low labour productivity may lead to inefficient resource utilization, delays in project completion, and increased construction costs [4], [5]. Therefore, accurate and systematic measurement of labour productivity is essential for evaluating actual project performance and providing a reliable basis for cost estimation, scheduling, resource allocation, and productivity improvement in construction projects [6], [7].



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Lightweight concrete block wall installation is one of the dominant activities in building projects [8]. This work is repetitive, requires significant time, and involves a relatively large amount of labour [9]. The productivity standard for this work typically refers to the Ministry of Public Works and Public Housing (PUPR) Work Unit Price Analysis (AHSP). The standardized productivity values specified in the AHSP provide a reference for construction planning and cost estimation, but their applicability to specific project conditions needs to be evaluated through direct field measurement. Such measurement provides site-specific productivity data and enables a more realistic assessment of construction performance under actual working conditions. [10]. However, actual productivity in the field often differs from the standard figures due to the influence of field conditions, weather, material availability, labour skills, and project management effectiveness [11], [12].

In building construction, lightweight concrete block wall installation represents one of the activities in which labour productivity plays an important role in determining the efficiency of construction operations [8]. The activity consists of repetitive work cycles, requires considerable working time, and involves substantial labour input [9]. In project planning and cost estimation, its productivity is commonly determined using the Work Unit Price Analysis (AHSP) issued by the Ministry of Public Works and Public Housing (PUPR) [10]. Nevertheless, the productivity values established in the AHSP may differ from actual field performance because labour productivity is affected by variations in working conditions, weather, material availability, worker skills, work methods, and project management effectiveness [11], [12]. This difference highlights the importance of direct on-site measurement to obtain realistic and site-specific productivity data that accurately reflect the actual conditions of lightweight concrete block wall installation. Such empirical data provide a more reliable basis for construction cost estimation, scheduling, and resource planning than relying solely on standardized productivity assumptions [13].

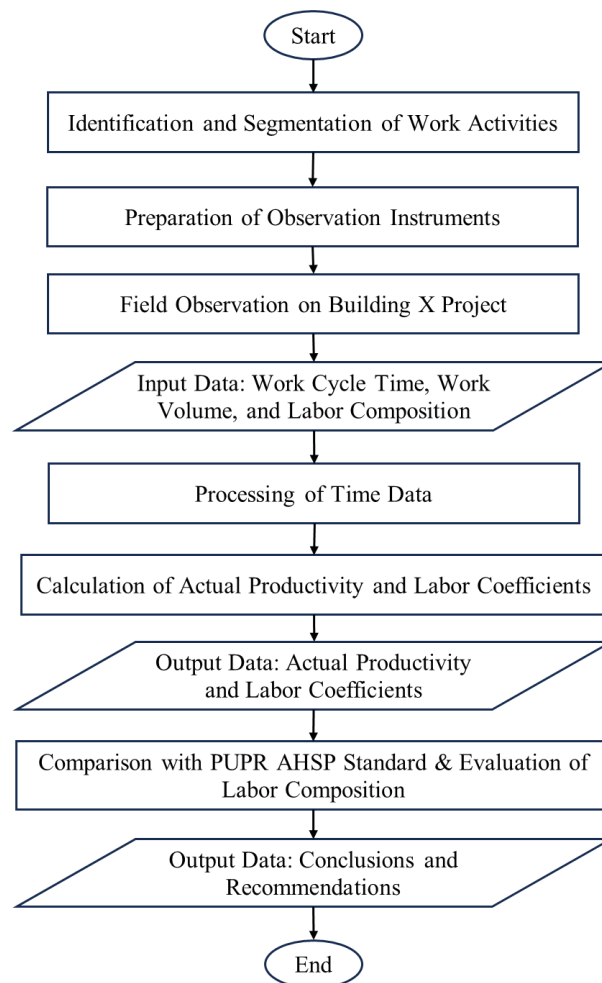
To accurately evaluate the difference between standard and actual labour productivity in lightweight concrete block wall installation, direct measurement under actual field conditions is required [13]. The time study method provides an effective approach for measuring labour productivity by systematically recording work cycles and determining normal time and standard time as the basis for objective productivity assessment [14], [15]. This method also enables the identification of unproductive activities and variations in work cycles, which can be used to evaluate work efficiency and formulate appropriate improvement strategies [16], [17]. Field productivity can vary according to construction methods, working conditions, material availability, worker skills, and project management, resulting in differences between actual productivity and the values specified in the AHSP [18]. Although the time study method has been widely applied to assess general construction labour productivity, its specific application to lightweight concrete block wall installation remains limited, presenting a significant research gap [19]. This study addresses this gap by offering a novel contribution through the direct measurement of lightweight brick productivity specifically in Tasikmalaya; this localized measurement is crucial because region-specific working conditions and labor behaviors often deviate significantly from generalized national standards, making local empirical data essential for accurate project planning. Therefore, direct time-based measurement is needed to obtain actual productivity values and provide a more representative comparison with the productivity standards specified in the AHSP [20].

Although labour productivity in construction has been widely investigated using various measurement approaches, a key gap remains in Indonesian construction literature regarding the direct time-based evaluation of lightweight concrete block wall installation. This study addresses this gap by applying direct time study to measure field productivity and systematically benchmarking the results against the official AHSP productivity standards used in Indonesian construction planning. This gap is important because differences between standardized productivity assumptions and actual field performance may affect labour requirements, project cost estimation, scheduling, and resource efficiency. The contribution of this study lies in the direct measurement of lightweight concrete block wall installation productivity using the time study method in a medium-scale building project and the comparison of the resulting productivity with the productivity standards specified in the AHSP. The study also evaluates the actual labour composition and its efficiency relative to the labour assumptions used in the AHSP. Accordingly, this study aims to quantify the productivity gap between actual lightweight concrete block wall installation and the AHSP productivity baseline on the Building X Project in Tasikmalaya, assess the efficiency of the actual crew ratio, and develop practical optimization

strategies to improve labour efficiency and support effective site management in similar construction projects.

2. Research Method

This research employs a quantitative approach with an observational and comparative method to measure the actual labour productivity of lightweight concrete block wall installation and compare it with the productivity standard specified in the Work Unit Price Analysis (AHSP). The time study method is applied to obtain objective productivity measurements based on direct observation of work cycles under actual field conditions. The research procedure consists of literature review, identification and segmentation of work activities, preparation of observation instruments, field observation, processing of time data, calculation of actual productivity, comparison with AHSP standards, evaluation of labour composition, and formulation of recommendations. The overall research procedure is presented in the research flowchart in **Figure 1**.



Source: Processed by Researcher (2025)

Figure 1. Research Flowchart.

The next stage involves identifying and segmenting the work activities involved in lightweight concrete block wall installation. The work process is divided into observable and repetitive activities to establish clear work cycles and facilitate systematic recording of working time. This segmentation also supports the identification of productive and unproductive activities during the observation process. After the work activities have been identified and segmented, observation instruments are prepared. The data collection instruments consisted of observation sheets, a digital stopwatch, and a video recording device. The observation sheet was used to systematically record work cycles, work volume, worker numbers and composition, and relevant field conditions. The digital stopwatch provided direct measurements of cycle times, while video recordings enabled subsequent verification of recorded times

and objective analysis of work activities. The combined use of these instruments enhanced data accuracy through double-verification of cycle times and supported a more precise assessment of activity patterns under actual field conditions. The stopwatch is used to record the duration of each work cycle, while video recording is used to document the work process and support the verification of the recorded time data.

Field observations are conducted directly during the lightweight concrete block wall installation work on the Building X Project in Tasikmalaya. The observations focus on the actual work cycles performed by the labour crew and the volume of wall installation completed during the observation period. The lightweight concrete block installation activity observed in the study is shown in **Figure 2**. The duration of each work cycle is recorded systematically using the stopwatch and supported by video documentation. Information regarding working conditions, material availability, work methods, and labour composition is also recorded to provide context for interpreting the productivity results. The recorded time data are then processed using the time study procedure. The observed work cycle times are systematically converted into normal time and standard time by incorporating worker performance ratings and appropriate work allowance factors. This procedure ensures that the resulting standard time accounts for real-world working conditions, including worker fatigue, necessary rest periods, and minor operational delays. The standard time obtained from the time study is then used as the basis for calculating actual labour productivity. Productivity is expressed in square metres per hour (m²/hour) or square metres per day (m²/day), using the following equation:

$$\text{Productivity} = \frac{\text{Work Volume (m}^2\text{)}}{\text{Standard Time (hours)}}$$

Where productivity represents the actual labour productivity, work volume represents the completed lightweight concrete block wall installation area, and standard time represents the time required to complete the work after considering the performance rating and work allowance factors. The actual productivity obtained from the time study is then compared with the productivity standard specified in the AHSP. The comparative analysis systematically evaluates both field-measured productivity and actual labour composition against the standardized assumptions specified in the AHSP. This comparison is intended to assess the extent to which the theoretical productivity and labour assumptions used in construction time and cost planning accurately reflect actual field conditions. This evaluation is conducted to determine the efficiency of the actual labour ratio and to assess whether the labour requirements assumed in the AHSP adequately represent the observed field conditions.



Source: Research Documentation (2025)

Figure 2. Lightweight Concrete Block Installation Work

The productivity comparison and labour composition analysis are subsequently interpreted in relation to the observed work conditions. Factors that may contribute to differences between actual productivity and AHSP productivity, such as working conditions, material availability, worker skills, work methods, and project management, are considered in interpreting the results. This analysis provides

a basis for assessing the applicability of AHSP productivity assumptions to lightweight concrete block wall installation under the observed project conditions. The final stage of the research consists of drawing conclusions based on the results of the time study, productivity comparison, and labour composition evaluation. The findings are used to determine the actual productivity level of lightweight concrete block wall installation, identify differences between actual productivity and AHSP standards, and evaluate the efficiency of the actual labour ratio. Based on this empirical evaluation, practical recommendations are formulated to help contractors and project managers develop more realistic and site-accurate estimates for construction time and cost planning in similar building projects.

3. Description and Technical

This section describes the research methodology, including the population and sample, sampling technique, operational variables, research instruments, and data analysis techniques used to evaluate the actual labour productivity of lightweight concrete block installation.

1. Population and Samples

The population comprises construction workers involved in lightweight concrete block installation at the Building X Project in Tasikmalaya. The sample consists of one work crew comprising 1 mason and 2 helpers (laden), observed continuously for 3 working days. Although this sample size is relatively small, it is considered sufficiently representative for this time study because lightweight concrete block installation is a highly repetitive construction activity with consistent and standardized work cycles. In such repetitive manual operations, intensive and continuous observation over multiple full working days is scientifically adequate to capture a vast number of cycle iterations, including natural daily variations such as worker fatigue, material preparation, and idle time, thereby ensuring the validity and reliability of the calculated normal and standard times

2. Sampling Techniques

The study uses purposive sampling, selecting a crew directly involved in lightweight concrete block installation with a consistent work composition. Direct observation was conducted continuously from 08:00 AM to 04:00 PM to capture the complete daily work cycle.

3. Definition of Variable Operations

The operational variables are defined as follows:

- a. Actual Productivity: Lightweight concrete block wall installed per day, expressed in m²/day.
- b. Time Distribution: Workers' activities classified as productive, supporting, and idle time.
- c. Labor Coefficient: Labor required to complete 1 m² of work, expressed in OH/m².
- d. Normal Time: Observed time adjusted according to the workers' performance rating.
- e. Standard Time: Normal time adjusted for applicable work allowances.

4. Instrument Analysis Tool

Field data were collected using a digital stopwatch, video recording device, and observation sheets. The stopwatch measured activity duration, video recordings documented work cycles, and observation sheets recorded activity classifications. Spreadsheet-based analysis was used for data processing and calculation.

5. Data Analysis Techniques

Data were analysed using a five-stage time study framework that systematically transformed direct field observations into standardized performance metrics. The stages comprised: (1) converting observed time into normal time using performance ratings; (2) determining standard time by incorporating work allowances; (3) calculating actual productivity and labour coefficients; (4) benchmarking actual field productivity against the AHSP productivity standard issued by the Ministry of Public Works and Housing (PUPR); and (5) evaluating the actual labour composition. This structured analytical pipeline provided a clear basis for translating raw observation data into measurable performance indicators and assessing field productivity against the government-established AHSP benchmark.

4. Results and Discussions

This section presents the results of the time study and their interpretation to evaluate the actual labor productivity of lightweight concrete block (Hebel) masonry work. The analysis covers work volume, working time distribution, labor coefficients, and the comparison of actual field performance

with the PUPR AHSP standard. The findings are discussed based on relevant theories and previous studies, with consideration of their theoretical, practical, and managerial implications.

4.1. Time Study Observation Results

The time study was conducted on one work crew consisting of one mason and two helpers (laden) over three consecutive working days, from 08:00 AM to 04:00 PM. The detailed work activities and their classification into productive, supporting, and idle time are presented in **Table 1** for Day 1, **Table 2** for Day 2, and

Table 3 for Day 3. This classification provides a structured framework for identifying operational bottlenecks and quantifying time-use efficiency throughout the observation period. The observations indicate a clear specialization of roles, with the mason focusing on direct block installation, while the helpers handled preparatory and logistical tasks, including mortar mixing, block cutting, material resupply, scaffolding installation, and work-area cleaning. This clear separation of tasks reflects an optimized labour structure that minimizes mason downtime and supports continuous installation activities. The recorded activities provide the basis for the subsequent analysis of working-time distribution.

Table 1. Time Study Results of Lightweight Block Work Day 1

Time		Mason 1		Helper 1		Helper 2	
Start	End	Activity	Type	Activity	Type	Activity	Type
08:00	08:15	Install block	p	Mix mortar	s	Resupply block	s
08:15	08:35	Install block	p	Cut block	s	Resupply mortar	s
08:35	08:45	Install block	p	Rest	idle	Cut block	s
08:45	09:10	Install block	p	Resupply block	s	Mix mortar	s
09:10	09:30	Install scaffolding	s	Install scaffolding	s	Install scaffolding	s
09:30	09:45	Rest	idle	Rest	idle	Rest	idle
09:45	10:15	Install block	p	Cut block	s	Resupply block	s
10:15	10:35	Install block	p	Mix mortar	s	Clean area	s
10:35	10:45	Rest	idle	Resupply block	s	Rest	idle
10:45	11:15	Install block	p	Cut block	s	Resupply mortar	s
11:15	11:45	Install block	p	Rest	idle	Cut block	s
11:45	12:00	Install block	p	Clean area	s	Rest	idle
12:00	13:00	Break	idle	Break	idle	Break	idle
13:00	13:20	Install block	p	Mix mortar	s	Resupply block	s
13:20	13:40	Install block	p	Cut block	s	Resupply mortar	s
13:40	13:50	Rest	idle	Resupply block	s	Cut block	s
13:50	14:15	install block	p	cut block	s	mix mortar	s

Time		Mason 1		Helper 1		Helper 2	
Start	End	Activity	Type	Activity	Type	Activity	Type
14:15	14:35	install scaffolding	s	install scaffolding	s	install scaffolding	s
14:35	14:45	rest	idle	rest	idle	rest	idle
14:45	15:10	install block	p	resupply block	s	cut block	s
15:10	15:30	install block	p	mix mortar	s	resupply mortar	s
15:30	15:45	install block	p	cut block	s	rest	idle
15:45	16:00	rest	idle	clean area	s	clean area	s

Source: Research Result (2025)

Table 2. Time Study Results of Lightweight Block Work Day 2

Time		Mason 1		Helper 1		Helper 2	
Start	End	Activity	Type	Start	End	Activity	Type
08:00	08:20	Install block	p	Resupply block	s	Mix mortar	s
08:20	08:35	Install block	p	Cut block	s	Resupply block	s
08:35	08:45	Install block	p	Resupply mortar	s	Rest	idle
08:45	09:05	Install block	p	Mix mortar	s	Cut block	s
09:05	09:25	Install scaffolding	s	Install scaffolding	s	Install scaffolding	s
09:25	09:35	Rest	idle	Rest	idle	Rest	idle
09:35	10:00	Install block	p	Cut block	s	Resupply block	s
10:00	10:20	Install block	p	Resupply block	s	Mix mortar	s
10:20	10:30	Rest	idle	Cut block	s	Resupply mortar	s
10:30	10:55	Install block	p	Mix mortar	s	Cut block	s
10:55	11:20	Install block	p	Cut block	s	Resupply block	s
11:20	11:40	Install block	p	Rest	idle	Clean up the work area	s
11:40	12:00	Install block	p	Clean up the work area	s	Rest	idle
12:00	13:00	Break	idle	Break	idle	Break	idle
13:00	13:15	Install block	p	Cut block	s	Mix mortar	s
13:15	13:35	Install block	p	Resupply block	s	Cut block	s
13:35	13:45	Rest	idle	Mix mortar	s	Resupply mortar	s
13:45	14:10	Install block	p	Cut block	s	Resupply block	s
14:10	14:30	Install scaffolding	s	Install scaffolding	s	Install scaffolding	s
14:30	14:40	Rest	idle	Rest	idle	Rest	idle
14:40	15:00	Install block	p	Mix mortar	s	Cut block	s
15:00	15:20	Install block	p	Resupply block	s	Resupply mortar	s
15:20	15:35	Install block	p	Cut block	s	Rest	idle
15:35	16:00	Install block	p	Clean up the work area	s	Clean up the work area	s

Source: Research Result (2025)

Table 3. Time study Results of Lightweight Block Work Day 3

Time		Mason 1		Helper 1		Helper 2	
Start	End	Activity	Type	Start	End	Activity	Type
08:00	08:25	Install block	p	Mix mortar	s	Resupply Block	s
08:25	08:40	Install block	p	Cut block	s	Resupply Mortar	s
08:40	08:50	Rest	idle	Resupply block	s	Cut Block	s
08:50	09:15	Install block	p	Rest	idle	Mix Mortar	s
09:15	09:35	Install scaffolding	s	Install scaffolding	s	Install Scaffolding	s
09:35	09:45	Rest	idle	Rest	idle	Rest	idle
09:45	10:10	Install block	p	Resupply block	s	Cut Block	s
10:10	10:30	Install block	p	Mix mortar	s	Resupply Mortar	s
10:30	10:40	Install block	p	Rest	idle	Cut Block	s
10:40	11:05	Rest	idle	Cut block	s	Resupply Block	s
11:05	11:30	Install block	p	Resupply block	s	Rest	idle
11:30	12:00	Install block	p	Rest	idle	Clean Up The Work Area	s
12:00	13:00	Break	idle	Break	idle	Break	idle
13:00	13:25	Install block	p	Resupply block	s	Mix Mortar	s
13:25	13:40	Install block	p	Cut block	s	Resupply Mortar	s
13:40	13:50	Rest	idle	Mix mortar	s	Cut Block	s
13:50	14:15	Install block	p	Cut block	s	Resupply Block	s
14:15	14:35	Install scaffolding	s	Install scaffolding	s	Install Scaffolding	s
14:35	14:45	Rest	idle	Rest	idle	Rest	idle
14:45	15:10	Install block	p	Mix mortar	s	Cut Block	s
15:10	15:30	Install block	p	Resupply block	s	Resupply Mortar	s
15:30	15:45	Install block	p	Cut block	s	Rest	idle
15:45	16:00	Install block	p	Clean up the work area	s	Clean Up The Work Area	s

Source: Research Result (2025)

4.2. Work Volume and Actual Productivity

The daily work volume obtained from direct field measurements can be seen in **Table 4**.

Table 4. Work Volume of Lightweight Block Installation

Observation Time	Work Volume (m ²)	Remarks
Day 1	12.60	Normal working conditions
Day 2	14.30	Normal working conditions
Day 3	9.70	Normal working conditions
Total Volume (3 Days)	36.60	
Average Productivity	12.20 m ² /day	

Source: Research Result (2025)

The total volume completed during the three observation days was 36.60 m², resulting in an average actual productivity of 12.20 m²/day. Daily output fluctuated between 9.70 and 14.30 m²/day despite generally consistent working conditions, highlighting the influence of daily operational

dynamics on field productivity. The highest output was recorded on Day 2 at 14.30 m², while the lowest was recorded on Day 3 at 9.70 m².

4.3 Working Time Distribution

The classification of working activities into productive, supporting, and idle time is presented in **Table 5**. The results show that the mason had a productive-time proportion of 77.38%, while the helpers spent 84.92% of their working time on supporting activities. This distribution demonstrates a clear division of labor within the crew. The high supporting-time proportion of the helpers indicates their important role in maintaining the continuity of the mason's productive activities. Effective coordination between the mason and helpers can therefore reduce interruptions and support consistent work productivity.

Table 5. Percentage of Working Time Distribution

Time Classification	Mason (1 Person)	Helper (Average of 2 Persons)	Activity Type
Productive Time (p)	77.38% (975 minutes)	0.00%	Lightweight block installation, leveling
Supporting Time (s)	9.52% (120 minutes)	84.92% (1.070 minutes)	Measurement, lightweight block cutting, mortar mixing, material supply
Idle Time (idle)	13.10% (165 minutes)	15.08% (190 minutes)	Brief rest, waiting for materials/instructions
Total	100%	100%	

Source: Research Result (2025)

4.4 Actual Labor Coefficients

Based on the total work volume and labor input during the observation period, the actual labor coefficients were 0.082 OH/m² for the mason and 0.164 OH/m² for the helpers. These results indicate the actual labor requirements for completing one square meter of lightweight concrete block wall installation under the observed field conditions. The lightweight concrete block installation process observed during the study can be seen in **Figure 3**.



Source: Research Documentation (2025)

Figure 3. Lightweight Concrete Block Installation Process

4.5 Comparison of Actual Productivity with PUPR AHSP Standard

The comparison between actual field performance and the PUPR AHSP standard can be seen in Table 6. The average actual productivity of 12.20 m²/day was substantially higher than the AHSP-based productivity of 7.69 m²/day, representing an increase of approximately 58.6%. This significant efficiency gain was achieved using a much leaner crew composition of 2 helpers to 1 mason, in stark contrast to the AHSP's assumption of approximately 5.16 helpers to 1 mason.

The primary reason the field crew achieved 58.6% higher productivity lies in the highly optimized division of labor and reduced spatial congestion. As indicated by the time distribution results, the 2:1 ratio allowed the two helpers to focus entirely on continuous supporting activities—such as material supply, block cutting, and mortar mixing—which kept the mason consistently supplied and enabled a high productive time proportion of 77.38%. A heavier ratio like the one proposed by AHSP could lead to unproductive overlapping of tasks and overcrowding in the work area. This finding aligns with Pahrūn et al. [18], who found that AHSP coefficients often overestimate labor requirements for masonry work, whereas actual field implementations with leaner, well-coordinated crews result in more optimal labor utilization.

Furthermore, the effectiveness of this streamlined coordination confirms the observations by Asmaroni and Sesaria [17], who noted in their time study research that identifying and minimizing non-value-adding activities through direct measurement often reveals that smaller crews perform more efficiently than standard theoretical models suggest. The substantial deviation from the AHSP baseline also underscores the impact of on-site management and worker dynamics. As highlighted by Surachman and Agustyawan [5], field productivity is heavily influenced by specific project environments, worker motivation, and active supervision—variables that static AHSP standards cannot fully capture. From a managerial perspective, these results strongly suggest that planning a leaner crew with continuous, well-managed material support is far more effective for lightweight concrete block installation than strictly adhering to standard AHSP labor ratios.

Table 6. Comparison of Actual Coefficient and Productivity with PUPR AHSP Standard

Parameter	Actual Field Data	PUPR AHSP Standard	Comparative Analysis
Mason Coefficient	0.082 OH/m ²	0.130 OH/m ²	More efficient (smaller field coefficient)
Worker Coefficient	0.164 OH/m ²	0.671 OH/m ²	Much more efficient
Worker : Mason Ratio	2 : 1	5.16 : 1	Field ratio is leaner and more optimal
Average Productivity	12.20 m ² /hari	7.69 m ² /hari	Field is 58.6% higher than standard

5. Conclusion and Suggestion

5.1 Conclusion

Based on continuous time study observations conducted over three working days at the Building X Project in Tasikmalaya, the installation of lightweight concrete block walls achieved higher actual field productivity than the productivity standard specified in the 2022 Ministry of PUPR AHSP. The results demonstrate that a work crew consisting of one mason and two helpers can effectively support lightweight concrete block installation through an appropriate division of tasks. The mason primarily performs the installation and leveling activities, while the helpers support material preparation, block cutting, mortar mixing, and material supply. This work organization enables efficient utilization of labor and supports the continuity of masonry activities. Overall, the findings confirm that the observed crew composition and task allocation provide an effective approach for lightweight concrete block wall installation under the conditions of the studied project.

5.2 Suggestion

Although the observed work efficiency exceeded the applicable standard, idle time among masons and helpers indicates opportunities for further improvement. Project management should optimize site logistics by placing lightweight concrete blocks and mortar directly adjacent to the active work zone and coordinating their supply timing to minimize worker waiting time and unnecessary material movement, thereby further reducing idle time. Future research should extend time study observations to

larger-scale and multi-story construction projects to verify whether the 1-mason-to-2-helper ratio maintains its efficiency under more complex material logistics, varied working heights, and site conditions.

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