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Eficiency Analysis of Mixer Truck Operations in Sudimara Forest Walk Apartment Project, Indonesia

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Abstract
This research was conducted with the aim of determining the productivity and operational efficiency values of the heavy equipment Mixer truck and conducting an analysis of the research data. This means that the purpose of this study is to find out the productivity value of the heavy equipment Mixer truck, then to understand the work efficiency achieved by the Mixer truck, and finally to determine how efficient the Mixer truck that has been used is. This research was conducted with the aim of determining the productivity and work efficiency of the heavy equipment mixer truck and performing an analysis of the collected research data. The analysis results indicate that the productivity achievable by the mixer truck is 28.48 m^3/shift, but in reality, only 22.89 m^3/shift was achieved, with a work time efficiency of the equipment in the field reaching 80.21% of the available time. The Physical Availability (PA) of the equipment showed an average value of 96.88%.

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Introduction

The rise in the quality of technology in today's way of life leads to the conclusion that we, as industry players, are racing against time. The position where technology is advancing rapidly and dynamically as it is now makes many companies strive to enhance their technological capacity in order to survive and continue thriving in increasingly competitive market conditions. In order to remain competitive or at least survive, industries, in this case companies, must find policies or strategies that align with technological trends so they can continue to compete while still providing satisfaction in presentation and service to consumers. Technological development moves rapidly, and as a result, the use of this technology becomes necessary for survival because companies must be able to correlate the work performed with existing technology under the umbrella of policies and decisions made. This technology touches all aspects and fields, including the construction sector. This is driven by technological advancements that pressure companies to carry out work as effectively as possible and produce as much output as possible. This is what has happened with one of the Sudimara Forestwalk Apartment Developments by a company, which has developed technology to be able to carry out its activities effectively and efficiently. The company then successfully developed itself in the precast and construction industry, with a business focus on construction, building management, and precast concrete. The company began to venture into city development, particularly the development of housing for low-income communities, which uses a lot of heavy equipment such as mixer trucks in its operations. Therefore, the objective of this paper is to analyze the productivity for more efficient operation of concrete mixer trucks in housing construction, in this case in the construction of the Sudimara Forestwalk Apartment.

Research Methodology

The data sources for this research were taken and divided into two types of data, namely primary data and secondary data. The primary data include cycle time of equipment of mixer truck, the activities and duration of concrete mixing process of batching plant, observation of the operator of equipment, observation of working hour of workers, and observation of access road to the construction site. The secondary data include location map of working zone, plan and actual production data, the number of equipment of mixer truck, the specification of equipment of mixer truck, and data of concrete mixing of the batching plant.

Literature Review

Heavy equipment plays a crucial role in construction by providing the necessary tools and machinery to perform various tasks efficiently. These machines are essential for tasks such as excavation, lifting, demolition, mixing concrete, and moving heavy materials. They are used in a wide range of construction projects, including highways, bridges, buildings, and other public structures. The selection on operation of heavy equipment depend on the specific requirements of the project, the environment in which it is being conducted, and time management concerns (Peurifoy *et. al*., 2023; Rostiyanti, 2002, Mochtar and Rosalia, 2023) [6, 5].

The operations of a concrete mixer truck invlove three main stages: loading, mixing, and transportation, and unloading. At the batching plant, the truck receives dry mixed ingredients such as cement, sand, and aggregates, along with water for subsequent mixing. During this phase the mixing drum rotates at low speed, lifting and initially mixing the materials. Once loaded, the truck transports the concrete to the construction site. During transportation, the mixing drum continuously rotates in a clockwise direction at a set speed, mixing the concrete using internal blades to prevent segregation and moisture separation. If the concrete becomes too stiff or dry during transit, additional water can be added via the water supply system to adjust the mix and concictency. Upon arrival at the construction site, the concrete is unloaded. If the concrete meets the required specifications, the unloading chute is aligned with equipment like concrete pumps or hoppers. The mixing drum rotates counterclockwise at an approriate speed to push the concrete along the blades towards the discharge opeing, completing the unloading process. After unloading, it is required to clean the the mixing drum. Water can be added, and thr drum rotated to prevent any leftover concrete from hardening inside the drum, ensuring its continued efficiency for future use (mixtruck.com, 2025).

According to Ervianto (2023) [2], productivity is defined as the ratio between output and input, or the ratio between the product result and the total resources used. This is indeed true and has been proven based on the author's calculations in terms of both equipment and human resources used, as in this case where the mixer truck serves as the equipment or delivery medium and the operator carrying out the work represents the human resources. And theoretically, according to Asiyanto (2008) [1], productivity is output divided by input. For the productivity of a tool, the output is taken from the work that can be completed by the tool in a given unit of time, for example meters per hour, while the input is the tool itself. There are two types of productivity known: tool productivity if the work is completed by the tool itself, and group tool productivity if the work is completed by more than one tool or a group of tools. The productivity of mixer trucks is a critical factor in construction projects, especially in foundry work. The productivity of mixer trucks can vary based on several factors, including equipment condition, work area conditions, work and time efficiency, work methods, and work volume (Jawat, Rahadiani, and Armaeni, 2018) [4].

Results And Discussion

The productivity of consturction equipment is highly depens on its working hours. For instance, daily productivity of mixer truck used in the construction of the Sudimara Forestwalk Apartment with 8-hour working hour. The mix design of concrete produced and daily activities of mixer truck in the project is presented in Table 1 and Table 2. Furthermore, it was found that the distribution of mixer truck usage and the cycle time is as shown in Table 3 and Table 4. It is also discovered there are obstacles of field operations, both the avoidable and unavoidable obstacles (Table 5). The avoidable obstacles include late in starting the safety meeting, break too early, late in resuming work after break, and too early to end the working hour. Those are avoidable by better field management in the project. On the other hand the daily preparation and maintenance is unavoidable obstacle because it is part of activity that must be conducted in the field operation. From the obstacle time, the productive time of mixer truck can be calculated, both with all obstacles (Table 6) and without avoidable obstacles (Table 7). Consequently, the actual productivity of truck mixer drops so that the work efficiency value of the heavy equipment mixer truck is 80.21%, and after optimizing the equipment's working time by removing avoidable obstacles, the equipment was able to reach 95.83%. (Hakim, 2023) [3].

Table 1: Composition of Produced Concrete per m3

MIX DESIGN	Concrete 60 Mpa
Fine Aggregate	1710 Kg
Coarse Aggregate	-
Cement	550 Kg
Viscocrete 305	4200 mm
Sika Tard 930 Accelerator	2000 ml
Water	165 L
MIXING TIME / M3	90 – 120 Second

Table 2: Daily Activities

Day Shift	Time	Working Description
1	05.00 – 06.30	Morning and Safety
	06.30 – 07.00	Preparation of Batching Plant
	07.00 – 11.30	Working
	11.30 – 13.00	Break
	13.00 – 16.30	Working
	16.30 – 17.00	Cleaning Up

Table 3: Distribution of the Mixer Truck Use

No.	Working (minute)	*Repair* (minute)	*Standby* (minute)	Total (minute)
1	231	0	249	480
2	294	0	186	480
3	368	0	112	480
4	256	120	104	480
5	222	0	258	480
6	313	0	167	480
7	361	0	119	480
8	314	0	166	480
Average	294.875	15	170.125	480

Table 4: Cycle Time of Mixer Truck

0.04	Mixer Truck				
	Concrete loading time to mixer truck (minute)	Time to Transport to Project (minute)	Transfer Time (minute)	Time to Return to Batching Plant (minute)	Total Time (minute)
1	10,34	21,35	7,03	21,15	59,97
2	11,40	22,24	7,11	22,10	62,85
3	11,20	23,10	6,57	21,15	62,02
4	10,35	24,15	6,55	22,18	63,23
5	12,17	22,20	6,50	23,06	63,93
6	10,53	23,15	7,20	21,27	62,15
7	11,24	23,30	6,53	24,15	65,22
8	10,47	21,15	7,30	23,29	62,22
		Total			501,49
Average Cycle Time= 501,49/8= 62,69 minutes					

Table 5: Field Obstacles of Mixer Truck Operations

Type of Obstacles	Desciption of Obstacles	Duration (minute/day)
Avoidable	Late in starting the safety meeting	13
	Break too early	10
	Late in resuming work after break	10
	Too early to end the working hour	42
Unavoidable	Daily preparation and maintenance	20
	Total	95

Table 6: Productive Work with All Obstacles

Type of Obstacles	Desciption of Obstacles		Duration (minute/day)
Avoidable	Late in starting the safety meeting		13
	Break too early		10
	Late in resuming work after break		10
	Too early to end the working hour		42
Unavoidable	Daily preparation and maintenance		20
A	Total Obstacles		95
B	Availabe Working Hours	8 hours	480
C	Productive Working Hours	A - B	385

Table 7: Productive Work without Avoidable Obstacles

Type of Obstacles	Desciption of Obstacles		Duration (minute/day)
Avoidable	Late in starting the safety meeting		0
	Break too early		0
Unavoidable	Late in resuming work after break		0
	Too early to end the working hour		0
	Daily preparation and maintenance		20
A	Total Obstacles		20
B	Availabe Working Hours	8 Jam	480
C	Productive Working Hours	A – B	460

Conclusions

From the observation in the project, it is discovered there are obstacles of field operations, both the avoidable and unavoidable obstacles The avoidable obstacles include late in starting the safety meeting, break too early, late in resuming work after break, and too early to end the working hour. Those are avoidable by better field management in the project. On the other hand the daily preparation and maintenance is unavoidable obstacle because it is part of activity that must be conducted in the field operation.

It was found that the work efficiency value of the heavy equipment mixer truck is 80.21%, and after optimizing the equipment's working time by removing avoidable obstacles, the equipment was able to be optimize to reach 95.83%.

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