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Mixing Tub and Washing Box for Finishing Work

Mulyadi Sugih Dharsono
Universitas Pradita, Indonesia
e-mail: mulyadi.sugih@pradita.ac.id

ABSTRACT

This tool aims to reduce the impact of dirt arising from the finishing work of a building. The tool consists of two main parts: the dolak (mixing tub), which serves as a place to prepare the mixture, and the washing box (or washing tub), which is used for cleaning work equipment. By combining these two functions into one tool, the scattering of plaster or paint mixture can be avoided. With the presence of a stirring tub and washing box for finishing work, the cleanliness of the surrounding road environment can be maintained during the project implementation period. Dirty asphalt settling work can be eliminated, thus saving project costs. The project site will remain cleaner compared to when using cement mix, as the stirring tub is directly connected to clean water and the sewer system. Additionally, the mixture used will be more economical, as less is wasted. The use of this tool should be included in the Standard Operating Procedures (SOP) for finishing work to ensure that cleanliness in the project environment is consistently maintained.

Keywords:
finishing work, stirring tub, plastering, paint, washing equipment, hygiene

INTRODUCTION

In housing cluster construction worldwide, maintaining cleanliness and environmental quality during the finishing phase remains a significant challenge. Cement, mortar, or paint residues often spill onto roads and surrounding areas, causing discomfort and dissatisfaction (Astuti, 2020; Lim & Jang, 2006; Tian, 2023). This issue is not limited to a local scale; many construction projects globally report similar problems, where conventional finishing methods generate excessive waste and inefficiencies, impacting both site cleanliness and overall project quality (Smith & Jones, 2019).

In Indonesia, particularly in cluster housing development, finishing works such as ceramic installation, painting, and ceiling installation are commonly executed using traditional tools like cast buckets, cement spoons, and roskam (MDPI, 2022; Zhang et al., 2020). These conventional methods frequently cause cement or paint mixtures to drip onto floors and streets, resulting in a dirty project environment (de Brito et al., 2020; Sabry, 2022). Additionally, the spatial separation between mixing sites and tool cleaning areas increases worker mobilization and wastes valuable time (Aparicio et al., 2022; Rutkowski & Rutkowski, 2015). Consequently, this leads to consumer complaints, as the final housing condition is perceived as untidy and unclean (Novandy et al., 2021; Phu et al., 2023).

Several studies have examined efficiency and cleanliness in construction finishing works. Agnese et al., (2018) found that adopting modern work methods and automated tools can reduce material waste and enhance site cleanliness. Prasetyo et al. (2021) highlighted the importance of optimizing the distance between mixing locations and work areas to minimize mobilization time and environmental damage. Rahman and Utami (2022) emphasized that implementing an integrated work system during the finishing phases significantly improves productivity while maintaining cleanliness and the aesthetic quality of the project.

This study distinguishes itself by focusing specifically on the conventional finishing work methods still prevalent in Indonesian cluster housing projects, linking practical site challenges with direct impacts on project environment quality and customer satisfaction. Unlike prior research that typically centers on general or technologically advanced approaches, this study investigates real-world practices and obstacles, proposing concrete, locally adapted solutions. This approach fills a gap by addressing the interaction between traditional finishing methods and site cleanliness management in the local housing sector (Authors, 2020; Irawan et al., 2020).

The study aims to identify the primary issues in finishing work processes that lead to environmental contamination in housing cluster projects and analyze the underlying factors. Furthermore, it seeks to propose more efficient and environmentally friendly work strategies to optimize finishing processes, thereby improving cleanliness, aesthetics, and consumer satisfaction (Wang et al., 2022).

The findings are expected to provide practical guidance for contractors, project managers, and housing developers to enhance the management of finishing works effectively and efficiently. Additionally, the research contributes to developing operational standards that emphasize cleanliness and environmental quality during finishing stages. It also serves as a valuable reference for future academic studies on innovative, environmentally sustainable construction techniques and management in the housing sector.

METHOD

In this era of Industry 4.0, competition is becoming increasingly fierce. For this reason, quality work results are a requirement for gaining a competitive advantage and ensuring the sustainability of business processes through various cost savings. The DMAIC Six Sigma problem-solving methodology has become one of the few techniques used to achieve quality work outcomes. This paper aims to demonstrate the application of the Six Sigma and DMAIC empirical methods in improving the quality of finishing work, specifically in enhancing cleanliness in the project environment.

According to Vincent Gasperz (2005), "Quality control is the operational techniques and activities used to fulfill requirements for quality." Quality control is an essential tool for management to improve product quality when necessary, maintain existing quality levels, and reduce the number of defective products or work results (Reksohadiprojo, 2000). Based on several previous definitions, it can be concluded that quality control is a technique and planned action carried out to achieve, maintain, and improve the quality of work results.

Problems arising in the work process must be immediately addressed by identifying the causative factors, followed by improvements to the quality of work through ongoing process identification. This can be achieved by applying the DMAIC methodology from Six Sigma. The DMAIC methodology is the key to Six Sigma problem-solving, which includes sequential improvement steps, each of which is critical to achieving the desired results. The first step in this study is to identify the Problem Solving Analysis of finishing work, then analyze the current problems using fishbone diagrams. Next, classify the quality characteristics that will be considered Critical to Quality (CTQ) using the Pareto method. Finally, the results of the analysis are used to seek improvements through a 5W+1H analysis to ensure the future improvement of the finishing work process, making it cleaner than the previous conditions.

Based on the problem-solving analysis shown in Figure 2, it is evident that during the finishing work, workers are expected to maintain cleanliness according to the established standards. The main problem in the finishing work process is the potential for pollution of the surrounding asphalt road, which leads to a failure to meet cleanliness standards. As a result, the project environment becomes dirty, even though the unit is expected to be handed over to consumers immediately. Therefore, in this study, in addition to identifying the main problem of the dirty finishing work process, the focus of this research is on developing a relatively practical work tool that can maintain the cleanliness of the project environment.

RESULT AND DISCUSSION

Define Stage

At this stage, the goals and objectives of improvement are determined, the object of the research is the finishing work, because this work is the last stage of each project. CTQ identification is developed from specifications sourced from Quality Control and Standard Operating Procedures in the developer. Cleanliness conditions must be maintained, the work results are according to standards, can reduce waste, save more materials and be completed on time.

Measure Stage

The creation of a pareto table to determine the most dominant factor against the dirtiness of the project environment during the finishing work which will later be identified as CTQ, the results of the pareto table as seen in table 1.

Table 1. Pareto table of the dirtiness of the project environment during finishing work

Code	Incident Element	Number of Incidents	Cumulative Incidents	%	Cumulative %
1	Work tools not appropriate	45	45	45	45
2	Less skilled workers	23	68	23	68
3	Conventional work method	15	83	15	83
4	Wasteful material	9	92	9	92
5	Work chasing targets	5	97	5	97
6	Inexperienced contractor	3	100	3	100
				100	

From the results of the pareto chart calculation, it was found that the dominant cause that contributed up to 45% of the dirt that occurred and which was qualified as CTQ so that immediate corrective action must be taken is an inappropriate work tool. In addition, the cleanliness of finishing work is 23% highly dependent on the skills of the craftsman, and 15% is due to conventional working methods.

Analyze Stage

Based on the results of the measure stage, it is known that the most dominant CTQ is inappropriate work tools, less skilled workers and conventional work methods. Furthermore, the evaluation carried out to determine the causes of environmental pollution that often occurs during the finishing work is explained by a cause-and-effect diagram which is a structured approach that allows for a more detailed analysis in finding the causes of a problem, inconsistencies and gaps

(Nasution, 2005) and evaluated based on a fishbone diagram as shown in figure 3. The results of the analysis show that there are six main problems in finishing work on a project, namely the availability of adequate work tools, work methods that comply with operational standards and procedures (SOPs), namely maintaining environmental cleanliness, labor skills, project value, the use of finishing materials that can minimize waste and resources, and the target completion time that must be achieved. The results of this identification were obtained from the results of literature studies and field studies, so that in the development of the finishing work process, it is necessary to consider the solution of problems in the literature and in accordance with field conditions.

The explained that the occurrence of unclean environmental conditions as an impact of finishing work is caused by several things, including: human factors as operators, competence of operators that are not in accordance with the field of work resulting in craftsmen having difficulty in doing their work because the skills between one handyman and another are different so that the impact of finishing work is often encountered, namely scattered materials. Then the absence of special tools for finishing work and how to do it and the pressure in the time required to work on time makes workers feel that there is greater pressure to do their work. The method factor, namely the lack of updating of the SOP for finishing work, makes the builder often neglect the finishing work that is not clean because of the scattering of materials which will also result in the waste of raw materials in addition to spending extra costs for cleaning again. Financial factors such as capital are felt to be lacking, causing contractors to reduce expenses during finishing work, then the craftsman becomes reduced both in quantity and quality. The equipment factor is the absence of special standard tools for finishing work making the work carried out with makeshift tools, resulting in the project environment that will be handed over to be damaged because of the rush to be completed to catch up with the handover time. d. Improvement Stage.

The fourth stage of the DMAIC methodology is Improve. At this stage, the root of the problem that has been found and explained at the analysis stage is corrected. The following is an analysis using the 5W+1H method. Based on the 5W analysis regarding the problem of dirt in the project environment due to finishing work so that it requires a tool to carry out clean finishing work. After the description to the problems of the finishing work is made, the main problem in the development of construction technology is obtained, namely the availability of the work tool production industry to make it easier for project workers to acquire tools. In addition, the innovation process in finishing work tools still has limitations in innovation for technological development and economic limitations to conduct development research. Here it can be seen that the main need is the process of making a tool even though not many people have thought about it. This is due to the income of project actors who are considered inadequate and the lack of motivation from developer companies who should be more concerned about environmental cleanliness during finishing work

a. *Control Stage*

The fifth stage of the DMAIC methodology is Control which in this writing aims to control the impact of impurities arising from finishing work. The designed tool includes a cement mixer with a special tub for the area of the house unit that is doing the flinching work, and the stirring tub can be brought into the house. Briefly as seen in the following pictures:

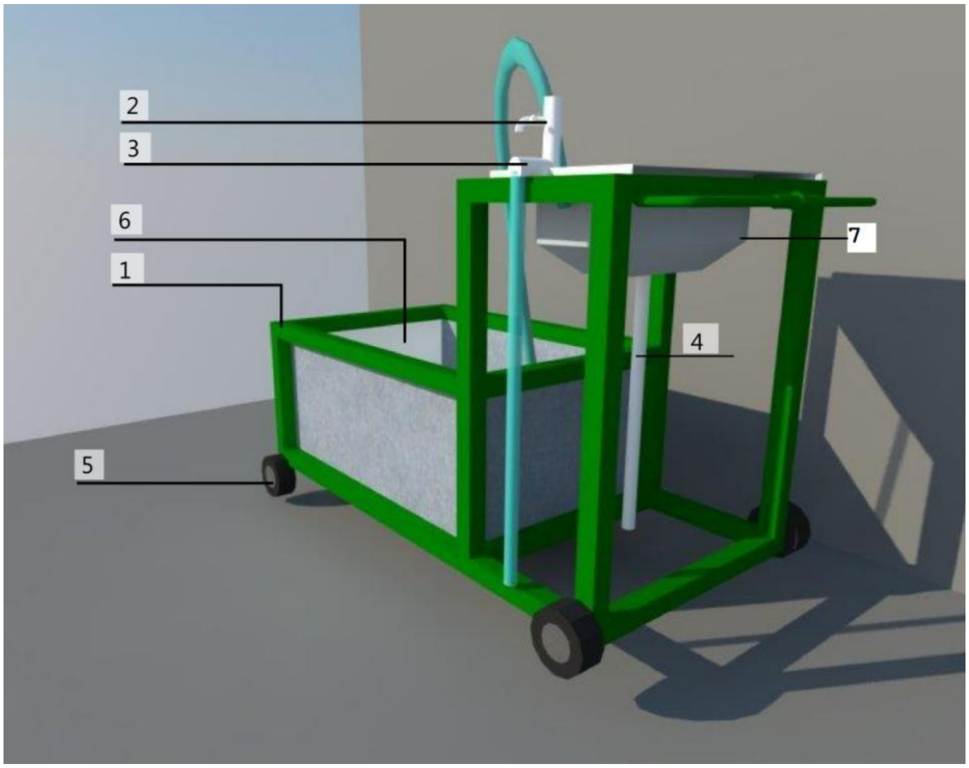


Figure 1. Perspective of stirring tub and washing box tools for finishing work

In picture 1, picture 6, picture 7, and picture 8; This tool is a frame assembly for the final work of the building consisting of: the first square frame (1a); the second square frame (1b) connected on one side of the width of the first square frame (1a) and has a higher height; mixing/dolak tub (6) placed on the first square frame assembly (1a); washing tub (7) which is placed on the second square frame assembly (1b); wheels (5) mounted under the first square frame (1a).

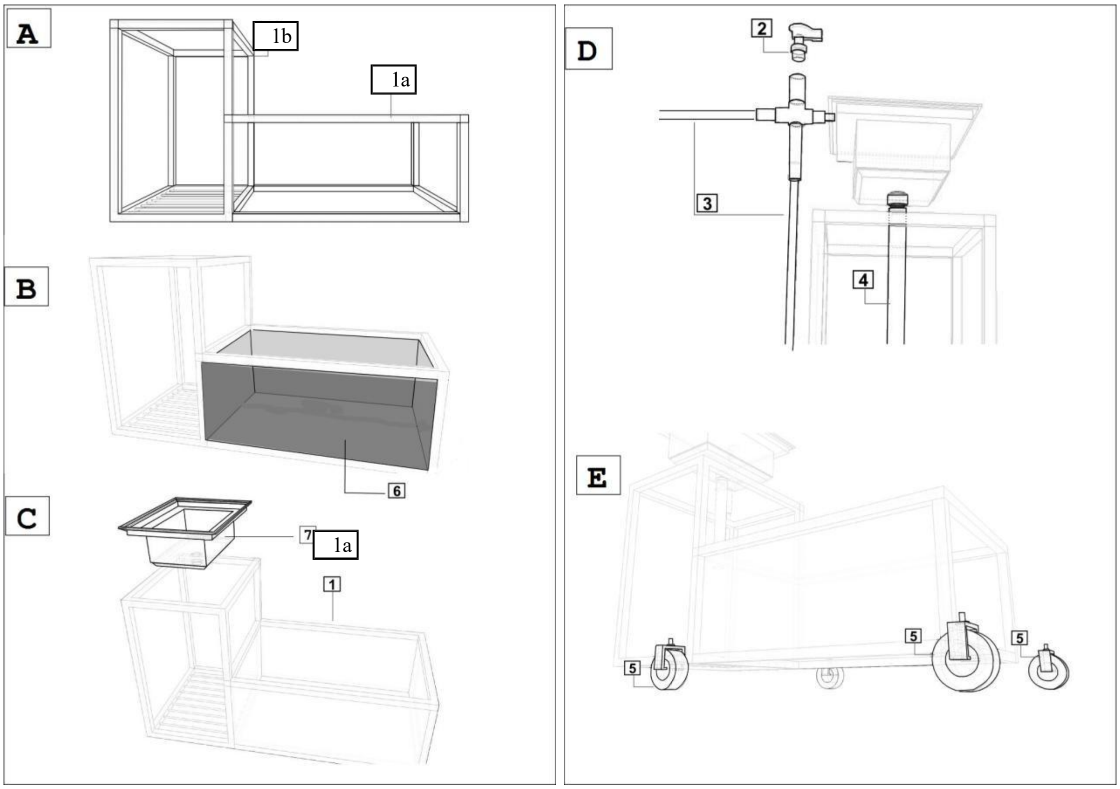
The dolak/tub (6) is in accordance with the shape and size or dimensions that do not exceed the width of the house door so that it can enter various rooms. Dolak (6) is made of iron plate and is made without corners for easy cleaning.

The washing tub (7) has a water faucet (2) installed on the side and is equipped with pipes (3) and a flexible drain hose (4). In the second square frame (1b), there are support legs (12) at both ends of the elbow so that the tool does not shake which can be raised and lowered to have a stronger footing when used.

The frame (1) of this tool is made of hollow iron according to the shape and size that has been determined. The first frame (1a) has a square shape connected to the second frame (1b) which is a higher square on one of the wide sides of the first square frame (1a). The connection of the two square frames uses a welding system.

Dolak (stirring tub) (6) is placed on the first square frame assembly (1a). Dolak (6) has the size and shape of the first square frame (1a), the dolak (6) joints are made of iron plates on the first square frame (1a) by way of a welding system and are made without corners for easy cleaning.

Figure 2. Main parts of the stirring tub and *washing box* for *finishing work*



The washing tub (7) is placed on the second square frame assembly (1b). The washing tub (7) is shaped and sized to fit the second square frame (1b). Since the second square frame (1b) is higher than the first square frame (1a), the position of the washing tub (7) is higher than the dolak (stirring tub) (6).

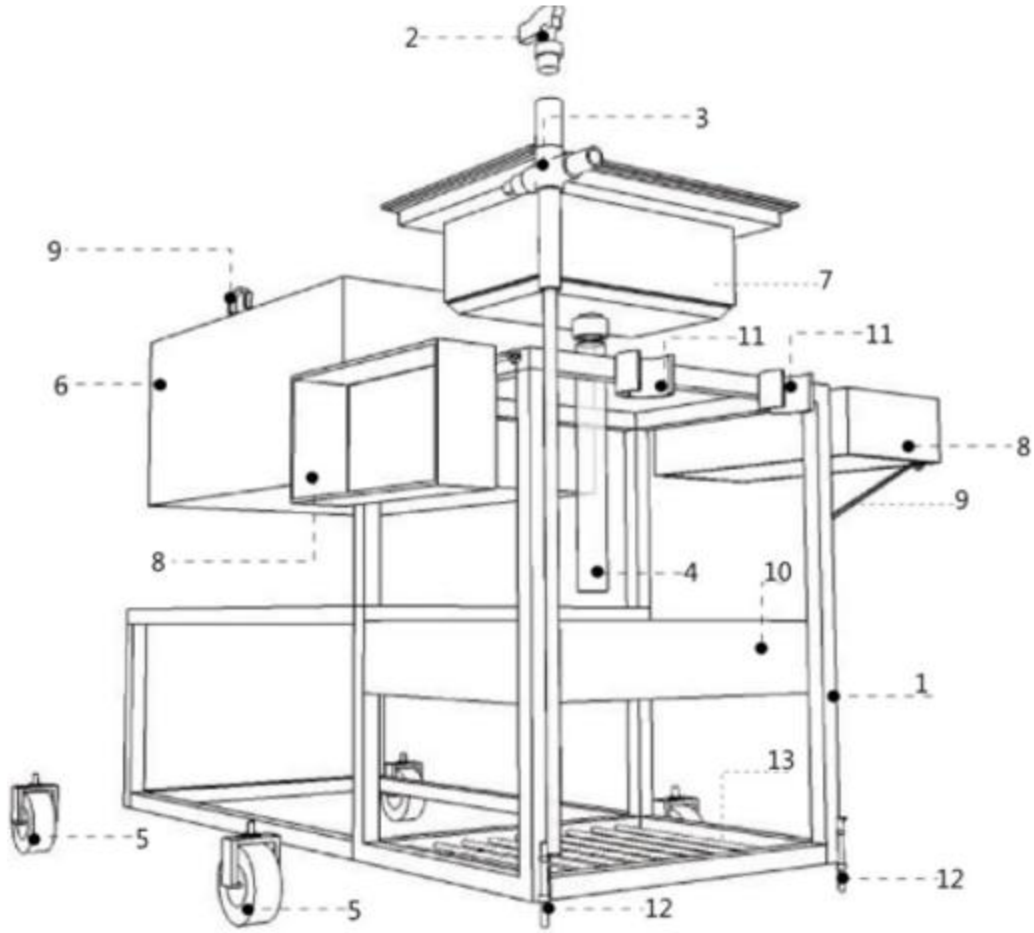


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Figure 3. Components of the stirring tub and *washing box* for *finishing work*

The water tap (2) is installed next to the sink (7) and is equipped with a hose (4) that can be connected to the water source to the required length and is equipped with flexible pipes for discharge into the municipal riol (dirty drainage channels). The wheels (5) of the rubber wheels are mounted under the first square frame (1a). The support legs (12) are located at the two ends of the elbow of the second square frame (1b). This support leg (12) can be raised and lowered to keep the tool from wobbling. In addition, this support leg (12) has the function of being a stronger footing when the frame assembly is used.

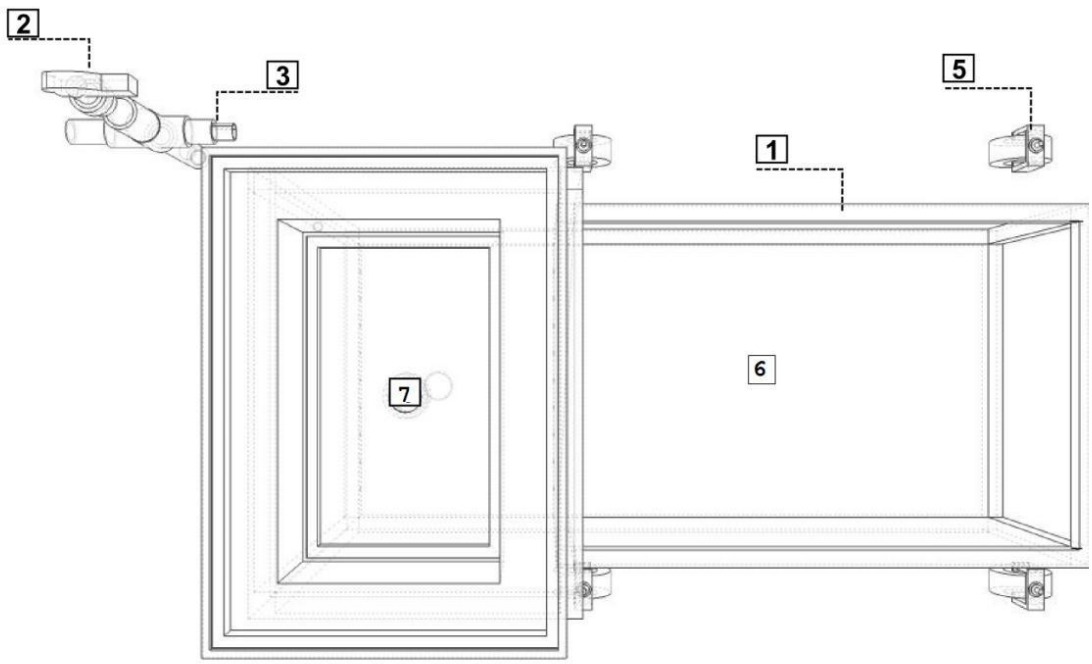

Figure 4. Top view of the stirring tub and washing box for finishing work

The frame assembly on this tool can be used in various final work activities such as shaft plaster repair work, for paint repair work, for ceramic repair work, for soaking floor/wall ceramics (depending on specs), for floor ceramic grout casting work, and for cleaning equipment.

In addition to the embodiment as described above, in the alternative embodiment, the appliance can have a shelf on the second square frame (1b) that is under the sink (7). The shelves are used as a place for tools and shelves for storing work tools. This can make it easier for craftsmen to apply and mobilize tools. In addition, a handle section can also be provided on the second square frame (1b) so that the frame assembly can be moved with it.

b. How to Use

In figure 9 there is a ready-made tool that is ready for use. The following is how to use the stirring tub and washing box for the final construction work:

1. Clean the dolak first before use.
2. Connect the water hose to the nearest water source, and the drain hose to the drain (drainage) area. Put the cement mixture material in the dolak according to the needle.
3. Stir the cement on top of the dolak that has been provided.
4. Do things related to washing the washing box.

How to Treat

The following is how to repair the stirring tub and washing box for the final work of the building:

1. Clean the dolak and washing box again after use so that dirt does not stick.
2. Dry the area exposed to water so that rust does not develop on the frame.
3. Do regular painting to reduce rust

c. Evaluation of Usage Results

Table 2. Advantages of Using Stirring Tubs and *Washing Boxes* for Finishing Work

NO.	FACTOR	CONVENTIONAL	STIRRING TUB & WASHING BOX
1.	Hygiene	Poorly maintained cleanliness	Cleanliness will be better maintained
2.	*Appearance*	Seems unprofessional, seems perfunctory in maintaining cleanliness	More professional look and neatly arranged equipment in the execution of *finishing work*
3.	Implementation and Materials	Less effective and efficient, large waste, a lot of materials are scattered	More effective in implementation and efficient in the use of materials
4.	SOUP	Legacy systems with work patterns that ignore project cleanliness	The creation of systems and work patterns that make contractors more concerned about Environmental cleanliness of the project
5.	Cost	Appear cost Cleaning and fireplace	Cheap investment in the long term

To maintain cleanliness during finishing work, the use of this tool must be included in the SOP. With these regulations and supporting equipment, the cleanliness of the cluster environmental roads can be realized during the project implementation period. There is no dirty asphalt painting work, so it can save cleaning costs. The project site is clean from cement mix, because the tub is directly connected to the sewer system and clean water. The mixture used can be more economical. A stirring sump that uses wheels, so that the tool can be easily moved to the job site. The following Table 2 shows the advantages of using stirring tub and washing box tools in finishing work in the project environment.

CONCLUSION

The manufacture of stirring tubs and washing boxes for finishing work aims to control the impact of dirt arising from defect repair work (during the inspection stage after the sales handover and during the warranty period for repairing consumer complaints). Defect repair is a task carried out when there is a complaint or damage to an area in one of the house units, requiring repairs to be made. With this tool, the cleanliness of the cluster environment roads can be maintained during the project implementation period. Dirty asphalt settling work can be eliminated, resulting in cost savings for the project. The project site will remain cleaner compared to cement mix, as the stirring tub is directly connected to clean water and the sewer system. Additionally, the mixture used will be more economical since less is wasted.

The use of this tool should be included in the Standard Operating Procedures (SOP) for finishing work to ensure that cleanliness in the project environment is consistently maintained.

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