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SMART BINDER FOR CONSTRUCTION WORKER AT SITE

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Abstrak: *The Smart Binder project seeks to enhance efficiency and quality in bricklaying processes for large-scale and medium-scale construction projects. Through the development and implementation of an innovative Smart Binder product is to produce and complete the Smart Binder, the project aims to reduce waste mortar, improve cost efficiency, save time, and enhance overall quality and aesthetics The methodology involves data collection through surveys, observations, and analysis of project records, followed by data analysis to derive insights into the effectiveness and impact of the Smart Binder product. The anticipated findings encompass increased cost efficiency, reduced waste mortar, heightened productivity, and improved quality in bricklaying operations. These outcomes hold considerable significance for construction professionals, project managers, and investors, as they furnish evidence-based insights for decision-making and contribute to the advancement of more efficient and sustainable construction practices. The project underscores the importance of stakeholder collaboration, ethical considerations, and adherence to industry standards. The abstracted findings and recommendations serve as valuable insights for the construction industry, encouraging the adoption of innovative technologies and practices to optimize bricklaying processes. Overall, the Smart Binder project represents a notable stride in the construction field, aiming to bolster efficiency and quality by deploying smart technologies and methods, ultimately driving sustainable and cost-effective bricklaying practices in large-scale and medium-scale construction projects.*

Kata Kunci: *Bricklaying,Brickworks, Construction Tools*

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Introduction

The construction industry is crucial for modern societies, with bricklaying being critical. However, this labor-intensive and time-consuming process leads to project delays and increased costs. The demand for innovative technologies and automated systems has increased, leading to an ambitious final-year project to develop a Smart Binder that revolutionizes traditional practices. The system will use innovation from other products in advanced algorithms to enhance speed, precision, and safety in bricklaying operations.

The system will design and implement a platform that autonomously arranges bricks according to predetermined patterns, under human supervision. This will reduce reliance on manual labor and speed up construction projects. The project will involve steel, roller, Polyethylene, and IoT material, which can improve recycling processes and promote sustainability. The recycled iron used for the product will be made more relevant for the price and will look like new. Time and Labor Constraints. The removal and cleanup of excess mortar require additional time and effort from bricklayers. They must manually scrape off the waste mortar, clean the work area, and ensure that the finished brickwork meets quality standards. These extra steps lengthen construction timelines and increase labor costs.

The primary objective of this project is to design and implement a platform capable of autonomously arranging bricks according to predetermined patterns, under the supervision of human operators. The system will leverage the surrounding environment, ensuring accurate brick placement. By automating the repetitive and physically demanding aspects of bricklaying, the proposed system will significantly reduce the reliance on manual labor, allowing construction projects to be completed faster and more efficiently.

Literature Review

Introduction

A literature review was conducted of several advances in brick fastener design, including those found in commercially available products, registered patents, research journal papers, and other sources. The formation of high-quality and reliable brickwork is not an easy task, but it can be overcome without involving a team of experienced craftsmen. The main thing is to use the right tools and devices in the work that will make the installation easier and faster

Study of products available in the market

The art of bricklaying is a crucial step in erecting a structure. This involves a medley of bricks melded together with a mortar mixture, layer upon layer, to construct a formidable brick wall. The customary course of action still employed today is to smear the mortar onto the brick surface with a spatula. Then, the mortar is applied to the brick head and the bricks are arranged atop the mortar bed. A firm tap to the surface ensures uniformity and a sleek, polished finish. A spirit-level tool is used to ascertain that the layer is smooth and even. To ensure uniform thickness, a gauge rod is employed to measure the mortar depth. The process is repeated until the final layer is complete. There are various types of products available in the market. Among those methods is the lift and pull method. These methods are used to allow the mortar that has been filled into the tool to be removed and spread along the surface of the brick. As for the conventional method, a tool such as a trowel is used to place and level the mortar on the brick. The pull method is a best-selling product in the market as well as an option for the design to be produced. (Alexander Solzhenitsyn, 2018)

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The deployment of robots and intelligent systems is rapidly developing, particularly in the construction industry. However, the construction industry often falls behind in implementing robotic systems due to the challenges in dynamic construction environments. This article presents a method to create digital layout plans for robotic bricklaying works. The idea for this method arose during a project involving ceramic block construction using a KUKA industrial robot. Upon searching the Espacenet database, 4673 results were found for the keywords "brick" and "robot." However, none of the selected robotic systems provided a reliable method for transporting objects from the Building Information Modeling (BIM) environment to the industrial robot environment. To use an industrial robot for bricklaying, detailed information about each element in the structure, such as position, dimensions, physical properties, shape, and connection, is required. This research aims to develop a methodology for creating a digital bricklaying plan based on BIM data. This research holds great promise for future applications, such as finishing works, plastering, painting, and robotic realization of paving and tiling. After digitization, mathematical optimization methods can be used to suggest optimal work procedures, reducing the time of robotic system deployment, energy consumption, and CO2 emissions. (Zakaria Dakhli, 2017)

Methodology

The methodology for the Smart Binder project involves a systematic approach to research and implementation. It encompasses several key steps to achieve the project objectives. Here is an overview of the methodology. Literature Review, conduct a comprehensive review of existing literature, research papers, and industry publications related to bricklaying techniques, waste reduction methods, smart construction technologies, and relevant best practices. This helps establish a solid foundation of knowledge and identifies gaps that the project aims to address. Next is data collection, determine the appropriate data collection methods to gather relevant information. This may include surveys, interviews, field observations, and documentation analysis. Collect data from construction sites, industry experts, stakeholders, and existing project records. Ensure the data collected aligns with the research objectives. We decided to run this project and produce sound absorption panels as our product. This is because based on studies and interviews that we have produced, we discovered that bricklaying abilities had a lot of shortcomings. So we have a plan to create a Smart Binder using it.

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Figure 1: Flow Chart Methodology

The purpose of gathering this data is to demonstrate that the issues raised are genuine and require attention. There are numerous ways to gather data or information, including questionnaires and practical testing. The test that will be running is time comparison and mortar residue when using The Smart Binder and using the conventional method. The complete study plan is outlined in this chapter. This section provides an explanation of the response rate about the users' initial impression of the Smart Binder along with feedback.

Procedure to produce the Smart Binder

Producing the Smart binder involves a systematic procedure that integrates all the product components, testing protocols, and quality assurance measures.

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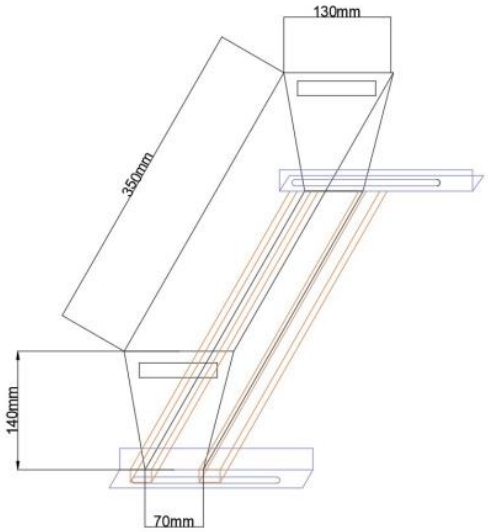

Figure 2 : Smart Binder Drawing

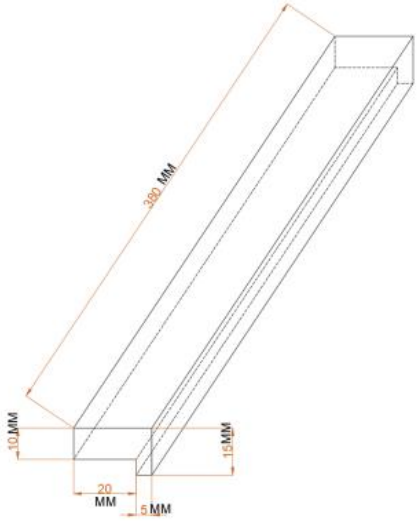

Figure 3 : Polyethelene Drawing

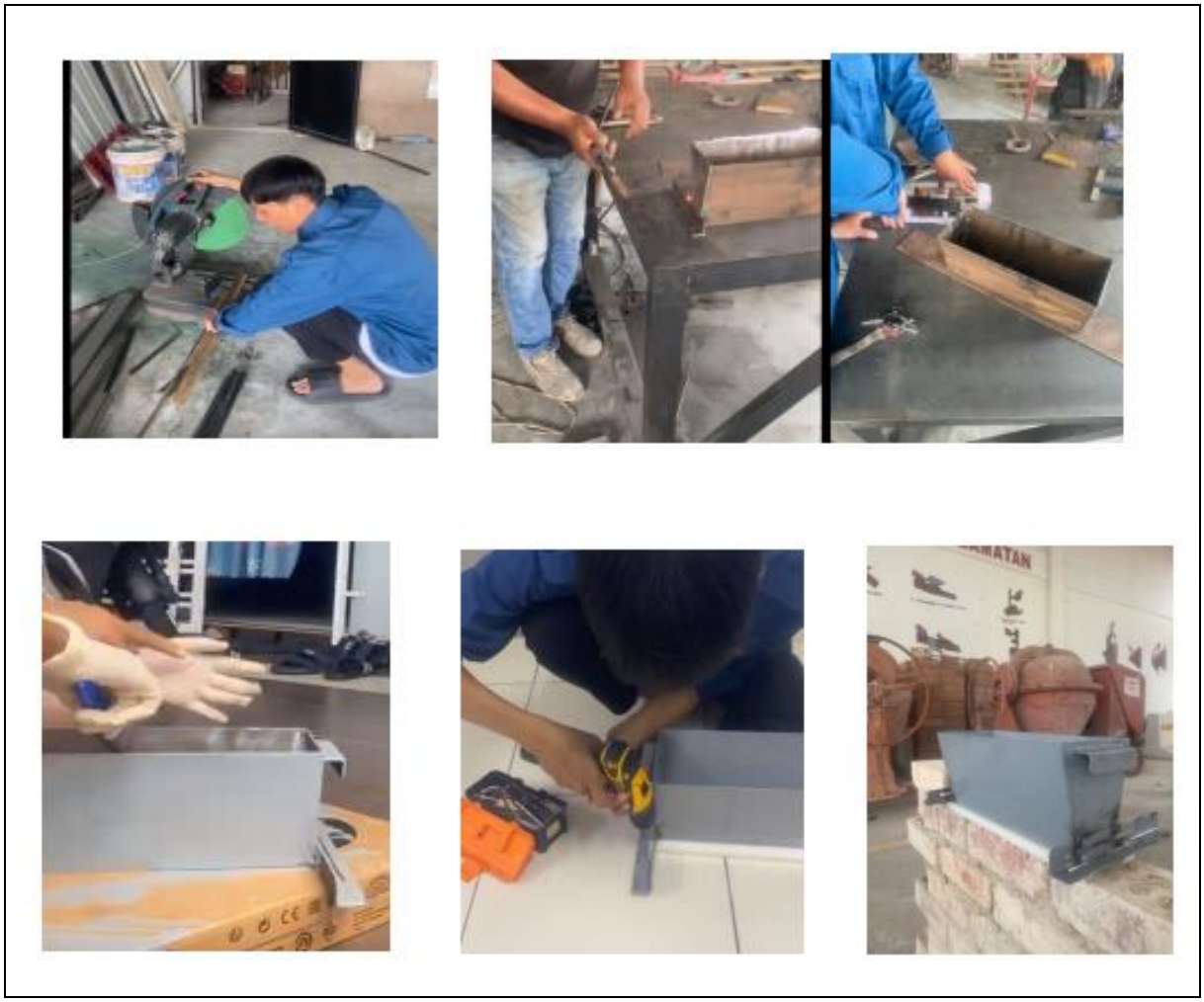

Figure 4: Smart Binder manufacturing works

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The methodology for data collection in the Smart Binder project involves a combination of several methods to gather relevant information and assess the product's performance and impact. These methods include surveys and questionnaires, field observations, performance metrics, and measurements, documentation, and records.

By utilizing these diverse data collection methods, a comprehensive understanding of the Smart Binder product's performance, effectiveness, and impact can be gained. The data collected through these methods allows for evidence-based decision-making and enables the project team to assess the product's success and identify areas for improvement.

Data Analysis And Discussion

Based on the results we have produced the smart binder, have tested the Smart binder to test its effectiveness of the smart binder which will be used as a level marker in innovation for bricklaying work, between the tests that have been carried out is the time test taken and the waste of the mortar used during bricklaying work using the smart Binder product and the conventional method commonly used in bricklaying work around the world.

The Smart Binder, a revolutionary innovation in construction technology, is set to revolutionize the bricklaying process. The company is comparing the time for bricklaying using the Smart Binder to conventional methods, aiming to quantify the transformative impact of its innovation on construction timelines. The Smart Binder, a testament to technological advancements, promises to redefine efficiency and precision in bricklaying processes. The data analysis aims to provide a quantitative measure of the time efficiency of the Smart Binder compared to conventional methods, offering insights into the speed and agility brought about by the technology. The primary focus of the analysis is the key parameter of time efficiency, which serves as a tangible metric for assessing the practical impact of the Smart Binder.

Analyzing the positive results from testing the Smart Bricklaying system in comparison to conventional methods provides valuable insights into the efficacy and advantages of the innovative product. The analysis can be structured as follows:

Time Comparison

Table 1: Time Comparison

Layers	Test parameter	Average Value (Smart Binder)	Average Value (Conventional Method)
First layer	2 meters	2min, 10sec	2min, 44sec
Second layer		2min, 14sec	2min, 48sec
Third layer		2min, 16sec	2min, 54sec

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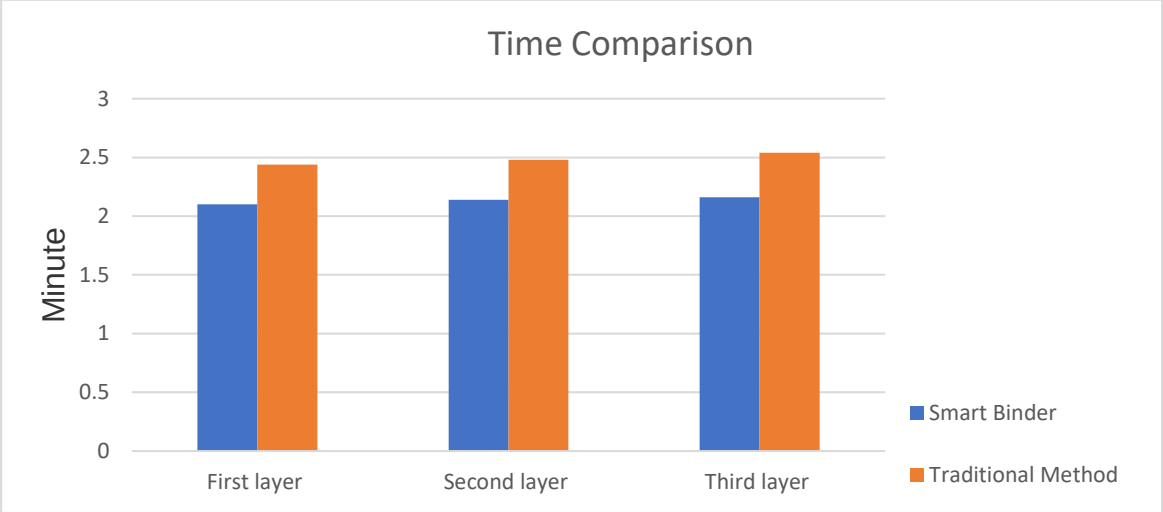

Figure 5: Time Comparison Graph

Quantify the time savings achieved with the Smart Binder compared to traditional methods. Break down the data to highlight specific stages of the bricklaying process where the system demonstrated notable efficiency gains. For instance, consider metrics such as time per brick laid, preparation time, and overall project completion time. Benchmark the results against industry standards and norms. Ensure that the Smart Bricklaying system not only meets but potentially exceeds the expected performance levels in terms of efficiency, quality, and sustainability. This can strengthen the product's position within the construction industry.

Mortar Residue

Table 2: Mortar Residue

Layers	Test parameter (Total)	Average Value (Smart Binder)	Average Value (Traditional Method)
First layer	5 kilograms	0.254 kg	0.369 kg
Second layer		0.296 kg	0.382 kg
Third layer		0.334 kg	0.404 kg

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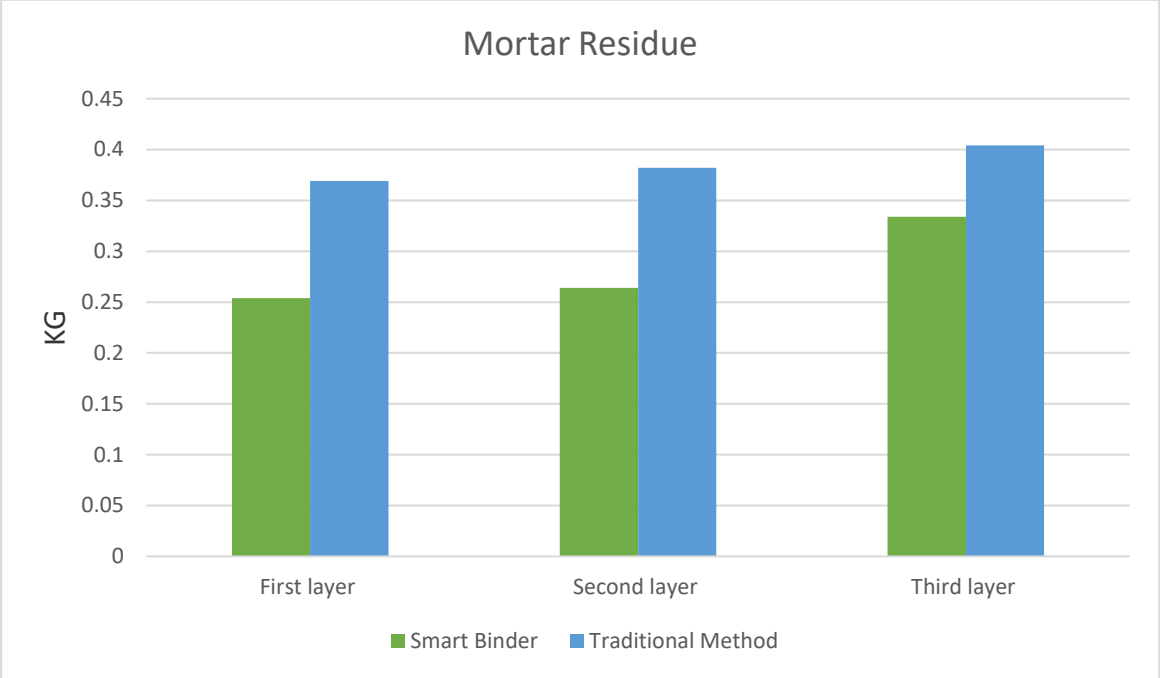

Figure 1: Mortar Residue Graph

Showcase the reduction in mortar waste achieved by the Smart Binder. Provide concrete data on the amount of mortar saved per unit area or project. This analysis could include a comparison of mortar usage between the two methods, emphasizing the sustainability and cost-saving benefits. Assess the quality of bricklaying achieved by the Smart Bricklaying system through qualitative and quantitative measures. This could include precision in brick placement, uniformity, and alignment. Consider seeking feedback from construction professionals regarding the perceived improvement in the overall quality of the constructed structures.

Conclusion

The conclusion about this Smart Binder product, this product can be described as successful. This is because this smart binder has succeeded in achieving its objective which consists of the first is to produce a product and the second is to conduct tests on the smart binder to test and record data in terms of the time taken and the resulting waste when doing brick binding work. It is also compared using 2 methods which first uses Product Smart Binder and the conventional method or the method that is usually done when tying bricks.

The production of the Smart Binder Product goes through the design phase from the AutoCAD drawing and then produced the Smart Binder at the Iron workshop in Serkam. Furthermore, the tests performed were successful in recording data and comparing with 2 types of methods where the data can be analyzed and translated. In the end, this Smart Binder Product successfully achieved its objective, and hope that the innovation added to this product can open the eyes of others to producing more innovative products in the bricklaying work in the construction industry.

As this project moves forward, it is poised to make substantial contributions to the construction industry, shaping the future of bricklaying practices. The Smart Binder is not just a product, it represents a transformative force that can redefine how structures are built, laying the groundwork for a more efficient, sustainable, and technologically advanced construction sector.

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