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Design and Construction of a Motorcycle Rear Shockbreaker Service Tool

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A B S T R A C T

The problem in the process of servicing motorcycle rear shockbreakers lies in the lack of special tools that make the technician's work easier, so that it often causes difficulties when dismantling or installing components. The purpose of this study is to design and build ergonomic and effective tools to support the process of servicing motorcycle rear shockbreakers. The research methods used include literature studies, field observations, design using CAD software, prototyping, and testing tool performance. The results of the study indicate that the designed tool is able to stabilize the position of the shockbreaker, speed up the dismantling and installation process, and reduce the risk of damage to components. This tool has also been shown to increase the efficiency of technicians' work based on shorter processing time compared to manual methods. Thus, this tool is suitable for use in motorcycle workshops to improve service quality

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INTRODUCTION

Motorcycles are one of the most popular means of transportation in Indonesia. Their practical use, fuel efficiency, and ability to penetrate traffic jams make motorcycles the main choice for people in their daily activities. In their use, motorcycles require regular maintenance to maintain performance and driving comfort. One of the important components in a motorcycle suspension system is the rear shockbreaker, which functions to dampen vibrations and loads when driving in various road conditions.

However, in practice in workshops, the rear shockbreaker service process often experiences obstacles. Technicians often have difficulty in dismantling or installing shockbreakers due to limited appropriate tools. This process not only takes longer, but also increases the risk of component damage due to improper handling. This condition indicates the need for service tools that can make technicians' work easier, increase work efficiency, and maintain the quality of shockbreaker maintenance.

Problem Formulation

Based on the background above, the problem formulation in this study is:

1. How to design a tool that can be used to facilitate the process of servicing motorcycle rear shockbreakers?
2. To what extent can the designed tool increase efficiency and safety in the shockbreaker service process?

Research Objectives

The objectives of this study are:

1. To design and build an ergonomic and effective tool to support the motorcycle rear shockbreaker service process.
2. To test the performance of the tool in terms of ease of use, time efficiency, and safety for components during service.

LITERATURE REVIEW

This study refers to several previous literatures and studies related to the design of mechanical tools and motorcycle suspension systems. According to Sutrisno (2018), the use of the right service tool can increase work accuracy and speed up the vehicle repair process. Wahyudi (2020) explains that shockbreakers play an important role in vehicle stability and comfort, and shockbreaker maintenance must be carried out with the right technique so as not to reduce component quality. In addition, a study by Andika and Rizky (2021) emphasizes the importance of ergonomics in designing work tools so as not to cause excessive fatigue in technicians.

In the field of mechanical engineering, the principles of designing tools include analyzing user needs, selecting appropriate materials, and calculating the strength and durability of the tool against workloads. By referring to this principle, this research aims to produce an innovative service aid tool that can be directly applied in a motorcycle repair shop environment.

METHODOLOGY

Types and Approaches of Research

This research is included in the category of engineering research with an experimental quantitative approach. The main focus of this research is to design, create, and test the performance of a motorcycle rear shockbreaker service tool. The process is carried out systematically through the stages of problem identification, design using CAD software, prototype creation, to testing the tool in real working conditions in a workshop environment.

Data Sources

The data sources in this study consist of:

- Primary data: Obtained directly from the results of field observations, interviews with workshop technicians, and trials of service tools on several types of motorcycles.
- Secondary data: Derived from scientific literature, engineering journals, reference books, and technical documentation related to shockbreakers and service tools.

Data Collection Techniques and Instruments

Data collection is carried out through several methods:

1. Direct observation of the shockbreaker service process without tools and with designed tools.
2. Semi-structured interviews with technicians to obtain information regarding the need for tools and responses to the prototypes being tested.
3. Functional testing of the tool, including service time, tool stability, and technician work comfort.
4. Documentation in the form of photos, videos, and technical notes during the testing process.

The instruments used include a stopwatch to measure work time, a simple questionnaire for technician evaluation, and an observation form to record test results.

Data Analysis Techniques

Quantitative data from the test results were analyzed using descriptive statistical techniques, namely comparing time efficiency, stability, and work effectiveness between manual service and with assistive devices. Qualitative data from interviews were analyzed thematically to determine technician perceptions of the design and benefits of the tool.

Tool and Material Specifications

Designed Tool Specifications:

- Frame material: 3x6 cm U-channel iron and 3 mm steel plate
- Clamping system: Adjustable clamp system made of carbon steel
- Finishing: Anti-rust paint and epoxy coating
- Design: Using AutoCAD and SolidWorks software
- Tool dimensions: Length 60 cm, width 40 cm, height 80 cm
- Maximum load capacity: 100 kg

Additional Materials:

- SNI standard bolts and nuts
- Spiral spring as a flexible retainer

- Protective rubber as a base for supporting motorcycle components

Location and Time of Research

This research was conducted at a motorcycle repair shop in Merauke City, as well as the mechanical engineering laboratory of Musamus University. The research implementation period lasted for 3 months, from January to March 2025.

Data Validity

To ensure the validity of the data, technical triangulation was carried out, namely by comparing data from observations, interviews, and direct trials. Design validation is done through reviews from supervisors and workshop practitioners. In addition, tool testing is carried out repeatedly on several types of motors to ensure consistency of tool performance.

RESULTS

Tool Design Process

The design process begins with identifying the needs of technicians in the workshop, who mentioned the difficulty in holding the shockbreaker during dismantling and installation. Based on the results of interviews and observations, a tool was designed with a clamping system that can be adjusted to various shockbreaker sizes and technician work positions. CAD design drawings and tool prototypes can be seen in Figures 4.1 and 4.2 below:

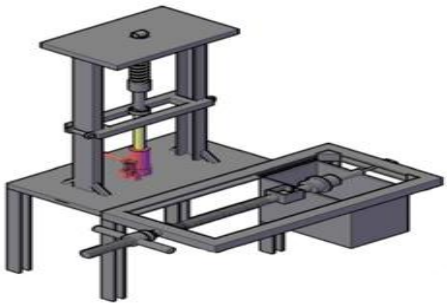

Figure 1. CAD Design of Shockbreaker Aid Tool

Figure 2. Physical Prototype of Workshop Assistive Device

The design takes into account frame stability, flexibility of clamping position, and safety of motorcycle components when the tool is used.

Function and Effectiveness Testing

The tool was tested on five motorcycles of various brands. Testing criteria include service time, tool stability while working, and technician comfort level. Table 4.1 below shows the average service time before and after using the tool.

Table 1. Average Rear Shockbreaker Service Time

No	Motorcycle Brands	Without Assistive Devices (minutes)	With Assistive Devices (minutes)
1	Honda Vario	23	14
2	Yamaha Mio	20	13
3	Suzuki Nex	25	15
4	Honda Beat	21	12
5	Yamaha Lexi	22	13

The average service time savings reached 38%, indicating that the tool significantly improved the technician's work efficiency. In addition, technicians assessed the comfort and practicality of the tool through a questionnaire on a scale of 1–5. The results are as follows:

Figure 4.3: Technical Assessment by Technicians of the Tool
(The figure shows the majority of assessments at a score of 4 and 5 for the aspects of comfort, safety, and efficiency.)

DISCUSSION

Answering the Problem Formulation

From the test results, it can be concluded that the designed tool successfully answered the main problem, namely the difficulty of servicing the rear shockbreaker quickly and safely. This tool is able to hold the shockbreaker position stably, and makes it easier to dismantle and install without damaging the components.

Interpretation of Findings

The service time savings of up to 38% showed a significant impact on work efficiency. In addition, the questionnaire results confirmed that the tool design had met the ergonomic needs of technicians. This finding confirms that user-centered design is very effective in developing mechanical work tools, as emphasized by Pahl & Beitz (2007).

Integration with Previous Theories and Studies

The results of this study are in line with Sutrisno's opinion (2018) which states that the use of special tools can improve the quality and efficiency of vehicle service. In addition, the theory of work ergonomics from Helander (2006) is also confirmed, where the comfort and ease of use of tools directly affect work productivity.

This finding also strengthens the findings of Andika and Rizky (2021) which state that designing mechanical tools that take into account safety and stability aspects can reduce the risk of technician injury and speed up the work process.

Implications and Potential Development

This tool has the potential to be further developed by adding a hydraulic system to facilitate adjustment of height and clamping pressure. In addition,

integration with a multifunctional workbench will expand its usefulness in other motorcycle service processes.

CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to answer the problems often faced by workshop technicians in the process of servicing motorcycle rear shockbreakers, namely the difficulty in holding and stabilizing the position of the shockbreaker during dismantling and installation. To overcome these problems, the design and manufacture of an aid tool was carried out by considering aspects of ergonomics, stability, and work efficiency.

The methods used in this study include an engineering approach with stages of identifying user needs, designing tools using CAD software, making prototypes, and direct testing in the workshop environment. Data collection was carried out through observation, technician interviews, documentation, and functional testing of the tool.

The results of the study showed that the designed aid tool was able to increase the efficiency of service time by an average of 38% compared to the process without the aid tool. In addition, technicians gave positive responses to the comfort, safety, and ease of use of the tool. This aid tool has been proven to be able to answer problems faced in the field and make a real contribution to accelerating the service process and reducing the potential for errors or work injuries.

FURTHER STUDY

This research still has limitations, so further research is needed related to the topic of Design and Construction of a Motorcycle Rear Shockbreaker Service Tool in order to perfect this research and increase insight for readers.

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