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Design and Manufacturing of Portable Line Boring Machine

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ABSTRACT

Earth moving equipment such as excavators and backhoe loaders are widely used in construction and industrial applications. The boom and arm of these machines are connected through pin joints, which experience heavy loads and continuous movement during operation. Over time, the bore holes at these joints become worn or oval due to friction and stress, leading to looseness, vibration, and reduced machine performance. During an industrial survey conducted in the MIDC area, it was observed that the repair of worn bores is commonly performed using conventional lathe machines. This method requires dismantling the boom or arm from the earth mover, lifting the heavy component using cranes or loaders, and transporting it to a workshop for machining. Such a process results in high downtime, increased labour effort, and additional maintenance cost. To overcome these challenges, this study proposes the design and development of a portable line boring machine capable of performing bore repair directly at the work site. The portable system allows the boring operation to be carried out without removing the component from the machine. This approach significantly reduces machine downtime, transportation cost, and repair complexity while maintaining machining accuracy. The proposed system provides a practical and economical solution for on-site maintenance of heavy construction equipment.

Keyword: - Portable Line Boring Machine, On-Site Machining, Earth Mover Maintenance, Bore Repair, Heavy Equipment Maintenance, Industrial Maintenance

1. INTRODUCTION

Earth moving machines such as excavators, loaders, and hydraulic cranes are essential equipment in construction and mining industries. These machines perform heavy-duty operations such as digging, lifting, and material handling. The boom and arm of these machines are connected through pin joints that allow rotational movement during operation. Continuous loading and friction at these joints gradually cause wear in the bore holes where the pins are fitted. When bore wear increases beyond a certain limit, the joint becomes loose and causes vibration and misalignment. This affects machine stability and may lead to structural damage if not repaired in time. Boring machines are commonly used in manufacturing industries to enlarge and finish existing holes to achieve better dimensional accuracy and surface finish. Boring is an important machining process used to produce precise internal cylindrical surfaces in mechanical components. In conventional repair methods, worn bores are restored by removing the boom or arm and machining it on a large lathe or boring machine in a workshop. This process involves dismantling heavy components and transporting them to the workshop using cranes or loaders. Such operations require considerable time, labour, and cost. Therefore, portable machining equipment that can perform ring operations directly on the installed component has become an important solution for heavy equipment maintenance.

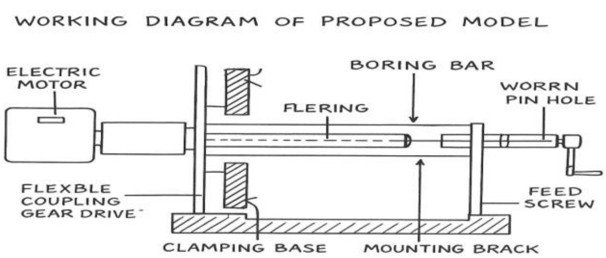

Fig.1 Working Diagram of Model

2. LITERATURE REVIEW

Several researchers have studied different approaches to improve boring machine performance and machining efficiency. Arjun M. S. and S. Nagendra Prasad discussed the automation of boring machines using PLC and HMI systems. Their work highlighted that manual boring machines often produce lower accuracy and inconsistent production rates. By using automated control systems such as PLC and servo drives, machining accuracy and operational efficiency can be significantly improved. [1] Research on machining accuracy has shown that proper alignment of the boring bar and stable support of the cutting tool are critical factors in achieving precise boring operations. Advanced boring techniques focus on maintaining dimensional accuracy and minimizing vibration during machining to ensure high-quality surface finish and reliable bore geometry. [2]
Studies related to portable machining equipment emphasize the importance of in-situ repair techniques for large industrial components. In-situ boring operations allow machining processes to be performed directly on installed machinery without dismantling heavy parts. This approach reduces equipment downtime and transportation cost while maintaining proper alignment of machine components. [3] Jangam et al. presented the design and fabrication of a portable drilling and boring machine that can perform machining operations at different locations without the need for large stationary machines. Their study demonstrated that portable machining systems provide flexibility, lower maintenance cost, and improved accessibility for repair work in industrial environments. [4]
Calculation of the Boring Bar Design for Static Rigidity and Strength studied the design and strength analysis of boring bars used in machining processes. The authors analyzed the effects of torsional load, static rigidity, and stress distribution on the boring bar during cutting operations. The study highlights that proper selection of bar diameter, material, and torque capacity is important to maintain machining stability and minimize vibration. Their research emphasizes the use of theoretical calculations such as polar moment of inertia and shear stress to ensure safe and efficient operation of boring bars.[5] Operating Properties of Deep Hole Boring Tools with Modified Design investigated the operational performance of boring tools used for deep hole machining. The study focused on tool rigidity, structural strength, and cutting performance under different machining conditions. The results showed that improving the design and stiffness of the boring tool helps reduce tool deflection and improves machining accuracy. The research also highlights the importance of stress analysis and design validation to ensure the durability and efficiency of boring tools during machining operations.[6]

3. PROBLEM STATEMENT

During a field visit and interaction with technicians in the MIDC industrial area, it was observed that worn bores in excavator booms and arms are typically repaired using conventional workshop methods. In this process, the damaged component is dismantled from the machine and transported to a workshop for machining. Since these components are large and heavy, cranes or front-hoe loaders are required to lift and position them on the lathe machine. The complete repair procedure includes dismantling, lifting, transporting, machining, and reassembling the component. This process results in long machine downtime and increased maintenance cost. In addition, handling heavy components increases labour effort and risk during maintenance operations. Therefore, there is a need for a portable boring system that can perform machining operations directly at the work site without removing the component from the machine. [3]

Fig.2 Wear And Damage Of JCB Boom Pin Hole

4. OBJECTIVES

• To study the problem of bore wear in earth mover boom and arm joints.
• To understand the maintenance difficulties faced in conventional repair methods.
• To design a portable line boring machine suitable for on-site repair work.

- To fabricate a compact and economical boring system for industrial maintenance.
- To reduce machine downtime and maintenance cost during repair operations

5. WORKING PRINCIPLE OF LINE BORING MACHINE

A line boring machine operates on the principle of internal machining using a rotating boring bar equipped with a cutting tool. The boring bar is positioned through the existing bore and supported by mounting brackets or bearing supports to maintain alignment. During operation, the boring bar is rotated using a motor drive system. The cutting tool attached to the bar removes material from the inner surface of the bore, gradually enlarging and restoring it to the required diameter. Proper alignment of the boring bar ensures accurate machining and uniform material removal. Portable line boring machines follow the same machining principle but are designed to be mounted directly on the machine component where repair is required. This allows the boring operation to be performed without dismantling the component. Portable machining systems are widely used in maintenance of heavy machinery because they provide flexibility and reduce repair time. [4]

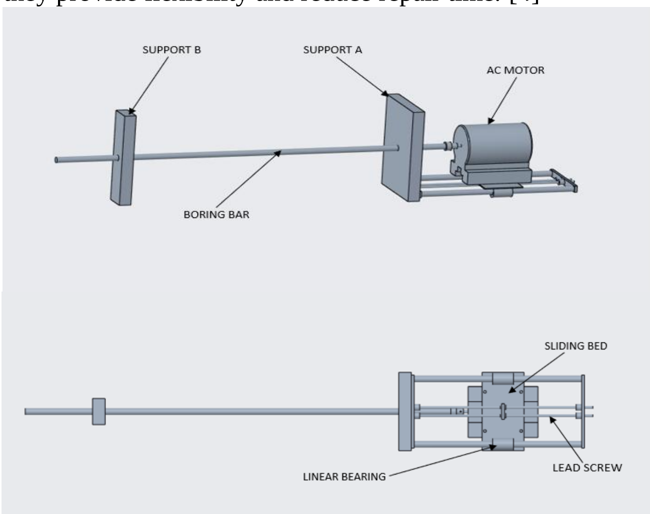

Fig.3. 3D View of Assembly

7. DESIGN CALCULATION

1. Motor Power
Motor power used in the machine:

$$1 \, HP = 746 \, W$$
$$Power = 0.5 \times 746$$
$$Power = 373 \, W$$

Motor Power = 373 W. [5][6]

2. Torque Produced by Motor
Formula:

$$P = \frac{2\pi NT}{60}$$

Where
P = Power (W)
N = Speed (rpm)
T = Torque (Nm)
Assume motor speed = 1440 rpm (typical single-phase motor)

$$373 = \frac{2\pi \times 1440 \times T}{60}$$
$$T = \frac{373 \times 60}{2\pi \times 1440}$$
$$T = 2.47 \, Nm$$

Torque produced by motor ≈ 2.47 Nm. [5][6]
3. Boring Bar Diameter
Given:

Diameter of boring bar
$d = 25 \, mm$
Radius
$r = \frac{d}{2} = 12.5 \, mm$. [5][6]
4. Polar Moment of Inertia of Boring Bar
Formula for solid shaft:
$J = \frac {\pi d^4}{32}$
$J = \frac {3.14 \times (25) ^4}{32}$
$J = 38349 \, mm^4$
Polar moment of inertia = 38349 mm^4. [5][6]
5. Shear Stress in Boring Bar
Formula:

$\tau = \frac {T \times r} {J}$
Where
T = Torque (2470 N/mm)
r = 12.5 mm
J = 38349 mm^4

$\tau = \frac {2470 \times 12.5} {38349}$
$\tau = 0.80 \, N/mm^2$

Shear stress ≈ 0.8 MPa. [5][6]
6. Power Transmission Check
Since mild steel shaft allowable shear stress:

$\tau_{allow} = 40 \, MPa$
Actual stress:
$0.8 \, MPa$
Therefore

$0.8 < 40$
Hence the design is safe. [5][6]
7. Cutting Speed (Assumption)
Formula:

$V = \frac {\pi D N} {1000}$
Assume bore diameter = 50 mm
$V = \frac {3.14 \times 50 \times 1440} {1000}$
$V = 226 \, m/min$. [5][6]

7. CONCLUSION

The research highlights the challenges associated with repairing worn bores of earth mover boom and arm joints using conventional workshop methods. The traditional repair process requires dismantling and transporting large components to machining workshops, which leads to increased downtime and higher maintenance cost.
The proposed portable line boring machine provides an effective solution for performing boring operations directly at the work site. By eliminating the need for dismantling heavy components, the system reduces labour effort, transportation cost, and repair time.
Portable machining technology has the potential to significantly improve maintenance efficiency in construction and heavy equipment industries by enabling accurate and economical on-site repair operations. [4]

8. REFERENCES

[1]. Arjun M. S., S. Nagendra Prasad, “Automation of Boring Machine Using PLC and HMI,” International Research Journal of Engineering and Technology (IRJET), 2018.
[2]. “Improving Machining Accuracy in Precision Line Boring,” International Journal of Advanced Manufacturing Technology, 2004.
[3]. Goldens Worldwide In-Situ Machining Services, Project Report on In-Situ Boring Operations.

[4]. Sushant Jangam, Vinay Joshi, Ninad Ghanekar, Sanket Davrung, “Design and Fabrication of Portable Drilling and Boring Machine,” VIVA-Tech Journal, 2021.
[5]. Karsakova et al., Calculation of the Boring Bar Design for Static Rigidity and Strength, Journal of Applied Engineering Science, 2023.
[6]. Kępczak et al., Operating Properties of Deep Hole Boring Tools with Modified Design, Materials Journal, 2024.