# Design And Development of Dual Side Shaping Machine for Productivity Enhancement in Small-Scale Industries

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***Abstract*— The manufacturing sector continuously demands higher productivity, reduced machining time, and economical machine tools. Conventional shaping machines are capable of machining only one work piece at a time, which limits production efficiency and increases operational cost. To overcome these limitations, this research paper presents the design and development of a Dual Side Shaping Machine capable of performing simultaneous shaping operations on two work pieces using a single drive system. The proposed machine utilizes a crank and quick return mechanism for converting rotary motion into reciprocating motion. A single electric motor drives dual rams simultaneously, thereby improving productivity while reducing energy consumption and machining time. The machine frame, shaft, pulley arrangement, and tool holding systems were designed considering strength, rigidity, and operational stability. The fabricated prototype was tested under different operating conditions. Experimental analysis showed a considerable reduction in machining time and an increase in production efficiency compared to conventional shaping machines. The developed machine is economical, compact, and suitable for educational laboratories, workshops, and small-scale manufacturing industries.**

***Keywords:*** **Dual Shaping Machine, Quick Return Mechanism, Productivity Improvement, Machine Tool Design, Manufacturing Technology, Simultaneous Machining.**

## I. INTRODUCTION

Machine tools are essential components of manufacturing industries because they provide the capability to shape, cut, and finish materials according to industrial requirements. Among various machine tools, shaping machines are widely used for machining flat surfaces, slots, grooves, and keyways. A shaping machine operates using reciprocating motion of the cutting tool while the work piece remains fixed on the work table. Conventional shaping machines are simple in construction and easy to operate, but they suffer from low productivity because only one work piece can be machined at a time. In modern industries where demand for mass production is increasing rapidly, productivity enhancement has become a critical requirement. Industries continuously search for methods to increase production rate while minimizing operational costs and floor space requirements. To address these issues, the concept of a Dual Side Shaping Machine was developed. The proposed machine uses a single motor drive to operate two shaping rams simultaneously. This arrangement enables simultaneous machining of two work pieces, thereby reducing machining time and improving machine utilization. The Dual Side Shaping Machine is designed using a mechanical power transmission system consisting of pulleys, shafts, crank mechanisms, connecting links, and reciprocating rams. The machine structure is fabricated using mild steel to provide sufficient rigidity and durability during operation. The present research focuses on the design, fabrication, testing, and performance analysis of the dual shaping machine. The study aims to demonstrate that simultaneous machining using a single power source can significantly improve production efficiency while maintaining low manufacturing cost.

## II. OBJECTIVES OF THE RESEARCH

The major objectives of this research work are:

1. To design and fabricate a Dual Side Shaping Machine capable of simultaneous machining.
2. To improve production efficiency compared to conventional shaping machines.

3. To reduce machining time using dual ram operation.
4. To utilize a single motor for driving two shaping mechanisms.
5. To reduce operational and manufacturing cost.
6. To develop a compact and economical machine suitable for small-scale industries.
7. To analyze the performance of the fabricated system.
8. To study the feasibility of dual-side machining operations.

## III. LITERATURE REVIEW

Several researchers have worked on productivity enhancement techniques in machine tools and shaping mechanisms.

Previous studies on shaping machines mainly focused on automation, quick return mechanisms, and power transmission systems. Researchers observed that conventional shaping machines have lower productivity because of idle return strokes and single work piece operation. Studies on Scotch yoke and quick return mechanisms showed that reciprocating motion can be generated effectively using simple mechanical systems. The quick return mechanism was found to reduce idle return stroke time and improve machining efficiency. Research related to dual-side machining systems indicated that simultaneous machining operations can significantly reduce production time. Some researchers proposed dual cutting tools and multi-tool systems for improving material removal rates. Recent developments in manufacturing systems also emphasized compact machine structures, low energy consumption, and economical fabrication methods suitable for small and medium-scale industries. Although many developments have been made in shaping mechanisms, limited research has been conducted on low-cost dual shaping machines suitable for workshop applications. Therefore, the present work focuses on designing and developing an economical Dual Side Shaping Machine capable of improving productivity with simple construction.

## IV. PROBLEM IDENTIFICATION

Conventional shaping machines face several limitations in industrial applications:

1. Only one work piece can be machined at a time.
2. Machining time is comparatively high.
3. Separate machines are required for multiple operations.
4. Higher operational cost for increased production.
5. Increased floor space requirement.
6. Lower productivity in mass production industries.

These limitations reduce manufacturing efficiency and increase production cost. Therefore, there is a need for a machine capable of performing simultaneous shaping operations using a single drive system.

## V. METHODOLOGY

The methodology adopted for the development of the Dual Side Shaping Machine is as follows:

1. Identification of industrial problems related to shaping operations.
2. Study of existing shaping machine mechanisms.
3. Conceptual design of dual ram arrangement.
4. Selection of suitable materials for fabrication.
5. Design calculations for shafts, pulleys, and power transmission system.
6. Fabrication of frame and mechanical components.
7. Assembly of the complete machine.
8. Experimental testing and performance analysis.
9. Comparison with conventional shaping machines.

## VI. WORKING PRINCIPLE

The Dual Side Shaping Machine works on the principle of converting rotary motion into reciprocating motion using a crank and quick return mechanism. The electric motor provides rotary motion to the pulley system through belt transmission. The pulley rotates the crankshaft, which is connected to the reciprocating ram mechanism. The crank mechanism converts rotary motion into reciprocating motion. Two rams are connected to the mechanism in such a way that both move simultaneously. Cutting tools mounted on the rams perform shaping operations on two separate work pieces. During the forward stroke, metal cutting takes place. During the return stroke, the cutting tool returns without machining. The quick return mechanism reduces the return stroke time, thereby improving machining efficiency. The simultaneous movement of dual rams enables machining of two work pieces at the same time, which increases productivity and reduces total machining time.

## VII. DESIGN OF DUAL SHAPING MACHINE

1 Design Considerations

The following factors were considered during machine design:

1. Strength of machine frame
2. Rigidity during machining
3. Power transmission efficiency
4. Ease of fabrication
5. Compact structure
6. Low manufacturing cost
7. Operational stability

2 Selection of Motor

A single-phase AC motor was selected as the prime mover.

Specifications:

1. Power: 1 HP
2. Speed: 1440 RPM
3. Supply: 230 V AC

3 Frame Design

The frame was fabricated using mild steel square pipes and plates. The frame provides support for all machine components and absorbs machining vibrations.

4 Shaft Design

The shaft was designed to transmit torque from the pulley to the crank mechanism.

Torque Calculation

Power transmitted:

$P = 1\ \text{HP} = 746\ \text{W}$

Motor speed:

$N = 1440\ \text{RPM}$

Torque:

$T = (P \times 60) / (2\pi N)$

$T = (746 \times 60) / (2 \times 3.14 \times 1440)$

$T \approx 4.95\ \text{Nm}$

Using torsion equation:

$T = (\pi/16) \times \tau \times d^3$

The calculated shaft diameter was approximately 20 mm.

5 Pulley Design

Pulleys were selected based on required speed reduction and torque transmission.

6 Ram Design

The ram was fabricated using mild steel sections. Proper guide ways were provided for smooth reciprocating motion.

## VIII. MATERIAL SELECTION

| Component | Material |
|---|---|
| Frame | Mild Steel |
| Shaft | EN8 Steel |
| Pulley | Cast Iron |
| Bearings | Ball Bearings |
| Tool Holder | Mild Steel |
| Connecting Rod | Mild Steel |

The selected materials provide sufficient strength, machinability, and cost effectiveness.

## IX. FABRICATION PROCESS

The fabrication process involved the following steps:

1 Cutting of Materials: Mild steel sections were cut according to required dimensions.

2 Welding: The machine frame was fabricated using arc welding.

3 Machining Operations: Shafts and connecting components were machined using lathe and drilling machines.

4 Assembly: All components including bearings, shafts, pulleys, rams, and tool holders were assembled carefully.

5 Finishing: The machine structure was painted to prevent corrosion and improve appearance.

## X. EXPERIMENTAL SETUP

The fabricated Dual Side Shaping Machine was tested under workshop conditions.

Experimental Parameters

- Motor speed
- Stroke length
- Machining time
- Surface finish
- Stability during operation

Mild steel work pieces were used for testing purposes.

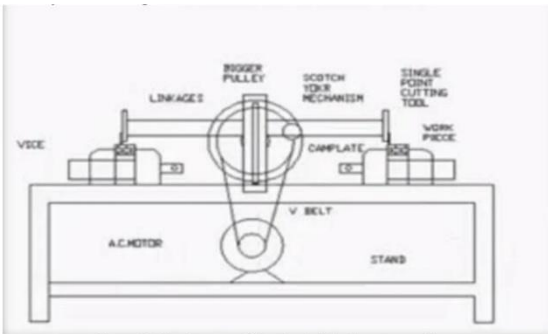

Figure1. The layout of the dual side shaper machine

## XI. RESULTS AND DISCUSSION

The developed machine successfully performed simultaneous shaping operations on two work pieces.

Observations

- Stable reciprocating motion was achieved.
- Simultaneous machining reduced total machining time.
- Machine vibration remained within acceptable limits.
- Smooth power transmission was observed.

Comparative Analysis

Parameter Conventional Shaper Dual Shaping Machine

| Parameter | Conventional Shaper | Dual Shaping Machine |
|---|---|---|
| Number of Work pieces | 1 | 2 |
| Productivity | Low | High |
| Machining Time | High | Reduced |
| Operational Cost | Higher | Lower |
| Power Utilization | Moderate | Better |
| Parameter | Conventional Shaper | Dual Shaping Machine |

The experimental results clearly indicate that the Dual Side Shaping Machine improves production efficiency compared to conventional shaping machines.

## XII. ADVANTAGES OF DUAL SHAPING MACHINE

1. Increased production rate.
2. Simultaneous machining operation.
3. Reduced machining time.
4. Better utilization of power.
5. Lower operational cost.
6. Compact and economical design.
7. Suitable for small-scale industries.
8. Reduced manpower requirement.
9. Improved machine utilization.

## XIII. LIMITATIONS

1. Suitable mainly for light-duty machining.
2. Alignment of dual rams requires precision.
3. Heavy-duty machining may produce excessive vibration.
4. Synchronization maintenance is necessary.

## XIV. APPLICATIONS

The Dual Side Shaping Machine can be used in:

- Mechanical workshops
- Educational laboratories
- Tool rooms
- Small-scale manufacturing industries
- Slot cutting operations
- Keyway machining
- Flat surface machining

## XV. FUTURE SCOPE

The future scope of this research includes:

1. PLC-based automation.
2. CNC-controlled dual shaping systems.
3. Hydraulic or pneumatic actuation.
4. IoT-based monitoring systems.
5. Servo motor integration.
6. Vibration analysis and optimization.
7. Automatic feed mechanisms.
8. Smart manufacturing integration.

## XVI. CONCLUSION

The present research successfully demonstrated the design and development of a Dual Side Shaping Machine capable of machining two work pieces simultaneously using a single motor drive. The fabricated machine showed significant improvement in productivity and reduction in machining time compared to conventional shaping machines. The developed system is compact, economical, and suitable for workshop and industrial applications. The project proves that simultaneous machining using dual ram arrangements can effectively improve manufacturing efficiency while reducing operational cost and power consumption. Therefore, the developed Dual Side Shaping Machine can serve as an economical and practical solution for small and medium-scale industries requiring higher productivity with limited investment.

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