Review Paper on Design and Development of Dual Side Shaping Machine

Prof. Shubham V. Kulkarni[1], Mr. Mayur B. More[2], Mr. Rudratej A. Mane-Deshmukh[3], Mr.Ranjeet N. Mane[4]
[1] *Assistant Professor, Mechanical Engineering, SMSMPITR AKLUJ (MS).*
[2, 3, 4] *B Tech Students, Mechanical Engineering, SMSMPITR AKLUJ (MS).*

***Abstract*—In modern manufacturing industries, productivity improvement and reduction in machining time are major requirements. Conventional shaping machines perform machining on only one work piece at a time, resulting in low production efficiency. To overcome this limitation, researchers have proposed Dual Side Shaping Machines capable of machining two work pieces simultaneously using a single drive mechanism. This review paper presents a detailed study of the design, fabrication, working principles, mechanisms, and recent developments in Dual Side Shaping Machines. Various research papers related to Scotch yoke mechanisms, quick return mechanisms, machine tool productivity enhancement, and dual-side machining are reviewed. The study highlights the advantages, limitations, and future scope of Dual Side Shaping Machines in industrial applications. The review concludes that Dual Side Shaping Machines significantly improve productivity, reduce operational cost, and provide an economical solution for small and medium-scale industries.**

***Index Terms*—Dual Side Shaping Machine, Scotch Yoke Mechanism, Quick Return Mechanism, Productivity Improvement, Machine Tool Design, Reciprocating Motion, Manufacturing Technology.**

I. INTRODUCTION

Machine tools play a vital role in manufacturing industries for shaping, cutting, and finishing operations. Among these machine tools, shaping machines are widely used for producing flat surfaces, grooves, and slots. A conventional shaping machine uses a single-point cutting tool and reciprocating motion for machining operations. However, conventional shaping machines suffer from low productivity because only one work piece can be machined at a time. Industries continuously seek methods to increase production while reducing machining time and operational cost. As a result, the concept of a Dual Side Shaping Machine has gained importance. A Dual Side Shaping Machine is designed to machine two work pieces simultaneously using a single motor and reciprocating mechanism. This arrangement improves production efficiency and better utilizes mechanical power transmission systems. Researchers have proposed various mechanisms such as Scotch yoke mechanisms and quick return mechanisms for achieving synchronized reciprocating motion.

II. OBJECTIVES

The objectives of paper are:

1. To study the working principle of Dual Side Shaping Machines.
2. To review different mechanisms used in dual shaping systems.
3. To analyze previous research works related to shaping machines.
4. To compare conventional and Dual Side Shaping Machines.
5. To identify research gaps in existing systems.
6. To study productivity enhancement methods.
7. To understand future developments in shaping machine technology.

III. CONVENTIONAL SHAPING MACHINE

A shaping machine is a reciprocating type machine tool used for machining flat surfaces. It operates using a single-point cutting tool mounted on a ram. The cutting action occurs during the forward stroke, while the return stroke remains idle.

Main Components
- Frame
- Ram
- Tool Head
- Work Table
- Crank Mechanism
- Electric Motor
- Feed Mechanism

Limitations of Conventional Shaper
- Low productivity
- Single work piece operation
- Increased machining time
- Higher operational cost
- Idle return stroke losses

These limitations motivated researchers to develop dual-side shaping systems.

IV. DUAL SIDE SHAPING MACHINE

A Dual Side Shaping Machine is an advanced shaping system capable of machining two work pieces simultaneously. The machine generally uses:
- Single motor drive
- Dual ram arrangement
- Scotch yoke or quick return mechanism
- Common power transmission system

The machine improves machining efficiency while reducing cost and space requirements.

Working Principle
1. Electric motor rotates the crankshaft.
2. Rotary motion converts into reciprocating motion.
3. Dual rams move simultaneously.
4. Cutting tools machine two work pieces together.
5. Forward stroke performs cutting operation.
6. Return stroke remains idle or quick return.

This arrangement reduces total machining time and improves industrial productivity.

V. LITERATURE REVIEW

5.1 Fabrication of Dual Side Shaper Machine using Scotch Yoke Mechanism

Researchers Veldi Kanakaraju et al. developed a dual-side shaping machine using a Scotch yoke mechanism. The machine was designed to improve production rate and reduce machining time. The study concluded that simultaneous machining significantly enhances productivity in small-scale industries.

5.2 A Dual Cutting Edge for a Single Tool Shaper Machine

Budarapu Pranav proposed a dual cutting-edge arrangement for shaping machines. The system enabled increased material removal rate and improved machining efficiency. The research focused on minimizing idle machine operation and improving output.

5.3 Kinematic Modeling and Simulation of Dual-Sided Shaper Machine

A recent study by Gamachis Ragasa Gutata et al. analyzed the kinematic modeling of a dual-sided shaping machine using Newton–Euler and Lagrangian approaches. MATLAB simulations were performed to study motion characteristics and system behavior. The study showed improved performance and smoother operation compared to conventional systems.

5.4 Design and Fabrication of Dual Shaper using Scotch Yoke Mechanism

R. Palani and team designed a dual shaper using a Scotch yoke mechanism to achieve simultaneous machining. The study focused on cost reduction, compact design, and ease of fabrication. Results indicated significant improvement in productivity and machine utilization.

5.5 Reconfigurable Machine Tool Systems

Researchers also explored reconfigurable shaping and slotting mechanisms to increase manufacturing flexibility. Such systems allow multiple machining operations using a single machine structure.

VI. MECHANISMS USED IN DUAL SIDE SHAPING MACHINE

6.1 Quick Return Mechanism

The quick return mechanism reduces return stroke time and improves machining efficiency. It is widely used in shaping machines.

Advantages
- Faster return stroke

- Reduced cycle time
- Improved productivity

6.2 Scotch Yoke Mechanism

The Scotch yoke mechanism converts rotary motion into reciprocating motion with fewer moving parts.

Advantages

- Simple construction
- Compact design
- Smooth operation
- Lower maintenance

The Scotch yoke mechanism is commonly preferred in Dual Side Shaping Machines due to its simplicity and efficiency.

VII. COMPARISON BETWEEN CONVENTIONAL AND DUAL SIDE SHAPING MACHINE

Parameter	Conventional Shaper	Dual Side Shaping Machine
Number of Work pieces	One	Two
Productivity	Low	High
Machining Time	Higher	Reduced
Motor Requirement	Separate for multiple machines	Single Motor
Operational Cost	Higher	Lower
Space Requirement	More	Less
Efficiency	Moderate	Improved

VIII. ADVANTAGES OF DUAL SIDE SHAPING MACHINE

1. Increased production rate.
2. Simultaneous machining operation.
3. Reduced machining time.
4. Better utilization of power.
5. Economical design.
6. Reduced floor space requirement.
7. Suitable for small-scale industries.
8. Lower maintenance cost.
9. Compact machine structure.

IX. LIMITATIONS

1. Suitable mainly for light machining applications.
2. Alignment of dual rams is critical.
3. Synchronization issues may occur.
4. Not suitable for heavy-duty industrial cutting.

X. APPLICATIONS

- Mechanical workshops
- Educational laboratories
- Small-scale industries
- Keyway cutting
- Slot cutting
- Flat surface machining
- Tool room applications

XI. RESEARCH GAP

From the literature survey, the following research gaps are identified:

- Limited automation in existing Dual Side Shaping Machines.
- Lack of CNC integration.
- Insufficient vibration analysis.
- Limited research on tool wear analysis.
- Need for improved precision and synchronization.
- Energy optimization studies are limited.

These areas provide opportunities for future research and development.

XII. FUTURE SCOPE

Future improvements in Dual Side Shaping Machines may include:

1. PLC-based automation.
2. CNC-controlled shaping systems.
3. Servo motor integration.
4. IoT-based monitoring systems.
5. Hydraulic and pneumatic actuation.
6. Smart sensor integration.
7. AI-based machining optimization.
8. Digital twin modeling for machine analysis.

XIII. CONCLUSION

This review paper presented a comprehensive study on the design and development of Dual Side Shaping Machines. Various research works related to Scotch yoke mechanisms, quick return mechanisms, and productivity enhancement techniques were reviewed. The study concludes that Dual Side Shaping Machines provide significant advantages over conventional shaping machines by increasing productivity and reducing machining time. The use of a single motor for simultaneous machining operations reduces operational cost and improves machine utilization. Although certain limitations exist, advancements in automation, control systems, and smart manufacturing technologies can further improve the performance and industrial applicability of Dual Side Shaping Machines. Therefore, Dual Side Shaping Machines represent an effective and economical solution for modern manufacturing industries.

REFERENCES

[1] Gamachis Ragasa Gutata, Galana Abay Kebede, and Gurmessa Horeta Abbera, "Kinematic Modeling and Simulation of Dual-Sided Shaper Machine using Newton-Euler and Lagrangian Approaches," Scientific Reports, 2026.

[2] Veldi Kanakaraju, Boda Ramesh, Manga Hymanjali, and Kanjarla Shyam Kumar, "Fabrication of Dual Side Shaper Machine using Scotch Yoke Mechanism," IJERT, 2019.

[3] Budarapu Pranav, "A Dual Cutting Edge for A Single Tool Shaper Machine," IJERT, 2020.

[4] R. Palani, Balamurugan K., Praveen A., Rajesh R., and Santhosh B., "Design and Fabrication of Dual Shaper using Scotch Yoke Mechanism," IJNRD, 2022.

[5] Ashutosh Singh et al., "An Approach to Develop Shaper Cum Slotter Mechanism: A Reconfigurable Machine Tool," Journal of The Institution of Engineers, 2019.

[6] Lu Zheng, Wanqun Chen, and Dehong Huo, "Review of Vibration Devices for Vibration-Assisted Machining," International Journal of Advanced Manufacturing Technology, 2020.

[7] Ian Gibson et al., "Hybrid Additive and Subtractive Machine Tools – Research and Industrial Developments," International Journal of Machine Tools and Manufacture, 2016.

[8] "Kinematic Modeling and Simulation of Dual-Sided Shaper Machine using Newton-Euler and Lagrangian Approaches" – Scientific Reports, 2026. Authors: Gamachis Ragasa Gutata, Galana Abay Kebede, Gurmessa Horeta Abbera.

[9] "Fabrication of Dual Side Shaper Machine using Scotch Yoke Mechanism" – IJERT, 2019. Authors: Veldi Kanakaraju, Boda Ramesh, Manga Hymanjali, Kanjarla Shyam Kumar.

[10] "Design and Fabrication of Dual Shaper using Scotch Yoke Mechanism" – IJNRD, 2022. Authors: R. Palani, Balamurugan K., Praveen A., Rajesh R., Santhosh B. "Kinematic Modeling and Simulation of Dual-Sided Shaper Machine: A Newton-Euler and Lagrangian Approach" – ResearchGate Preprint, 2025.

[11] "Dynamics Simulation and Analysis of Scotch Yoke Mechanisms with Opposed Dual-Piston and Inclined Slot Configurations using ADAMS" – Journal of Physics Conference Series, 2025

[12] "Design and Fabrication of Multi Process Machine using Scotch Yoke Mechanism" – IJERT, 2019.

[13] "An Approach to Develop Shaper Cum Slotter Mechanism: A Reconfigurable Machine Tool" – Journal of The Institution of Engineers.