



## Design and Development of hydraulic C- Clamp

<sup>1</sup>Prof. Annirudh Bhoi, <sup>2</sup>Sunnykumar Chilami, <sup>3</sup>Vaibhav Raut, <sup>4</sup>Sagar Chavan, <sup>5</sup>Shubham Jagtap, <sup>6</sup>Omkar Chavan.

<sup>1</sup>Assistant Professor <sup>2, 3, 4, 5, 6</sup>UG Scholar

<sup>1, 2, 3, 4, 5, 6</sup>Mechanical Engineering

<sup>1, 2, 3, 4, 5, 6</sup> Dr. A. D. Shinde College of engineering, Gadhinglaj, Maharashtra, India

**Abstract:** This project aims at designing and manufacturing a semi-automated hydraulic c clamp that can perform pressing operations without the involvement of any human operator. This project is selected because no such machines are available in these industries. Introducing a semi-automated hydraulic c clamp in the industries will help the industries prosper and make operations safe and easy. Moreover, the project will have a greater impact on the metal industries. The machine will be capable of performing fast and accurate alignment of metal operations.

Here we are fabricating the model for press operation and it is known here we are fabricating the model for press operation as a hydraulic press machine or hydraulic C clamp. Hydraulics is a topic in applied and it is known science and engineering dealing with the mechanical properties of liquids. Fluid mechanics provides the theoretical foundation for hydraulics, which focuses on the engineering uses of fluid properties. In fluid power, hydraulics is used for the end of the system as a piston with a small cross-sectional area driven by a lever to increase the force. Small- diameter tubing leads to the other end of the system generation, control, and transmission of power by the use of pressurized liquids, here our system to making of pressing operation. The hydraulic press depends on Pascal's principle: the pressure throughout a closed system is constant.

**Index Terms – Hand break, break, automation, hand**

### I. INTRODUCTION

II. A hydraulic C-clamp is a specialized tool used for clamping and holding objects securely during various applications, such as welding, metalworking, woodworking, and automotive repairs. It operates on the principles of hydraulics, utilizing fluid pressure to generate clamping force. Here is a detailed introduction to hydraulic C-clamps: Design and Construction: Hydraulic C-clamps typically consist of the following components: Frame: The main body of the clamp, often made of heavy-duty steel or cast iron, providing stability and durability. Fixed Arm: The stationary arm attached to the frame, opposite the moving piston Hydraulic Cylinder: Located inside the frame, the cylinder contains a piston that moves when pressure is applied, generating clamping force. Pump and Handle: Used to apply hydraulic pressure to the cylinder. The pump may be manually operated or powered by an electric, pneumatic, or hydraulic system. Release Valve: A valve used to control and release hydraulic pressure, allowing for easy adjustment and release of the clamp.

III. Operation:

IV. The operation of a hydraulic C-clamp typically involves the following steps:

V. The hydraulic C-clamp typically consists of a C-shaped frame made of sturdy materials like steel or cast iron. The frame features a fixed jaw on one side and a movable jaw on the other side. The jaws are usually equipped with hardened and serrated surfaces to ensure a firm grip on the workpiece. What sets the hydraulic C-clamp apart from traditional manual C-clamps is its hydraulic system. It utilizes hydraulic pressure to generate clamping force, providing significant advantages in terms of power, control, and ease of use. The hydraulic system is typically operated by a manual hydraulic pump or an electrically powered hydraulic pump, depending on the specific model.

VI. The clamping force generated by the hydraulic C-clamp can be easily adjusted by controlling the hydraulic pressure, allowing for precise and consistent clamping pressure as required by the application. This feature is particularly beneficial when working with delicate or sensitive materials that maybe prone to damage under excessive force. Another advantage of the hydraulic C-clamp is its ability to maintain constant clamping force over an extended period. Unlike manual clamps that may gradually loosen due to vibrations or

material deformation, the hydraulic system helps to maintain a secure and steady grip throughout the operation.

VII. Applying Pressure: The pump is operated or activated to pressurize the hydraulic fluid, which then applies force to the piston inside the cylinder.

VIII. Clamping Force: As hydraulic pressure builds, the piston moves forward and exerting a clamping force on the workpiece.

IX. Holding and Locking: Once the desired clamping force is achieved, the release valve can be closed to maintain the pressure and securely hold the workpiece in place.

X. Benefits and Applications:

XI. Hydraulic C-clamps offer several advantages over traditional mechanical clamps:

XII. High Clamping Force: Hydraulic systems can generate significant force, allowing for secure clamping of heavy or resistant materials.

XIII. Easy Release: The release valve allows for quick and effortless release of the clamp, enhancing efficiency and productivity.

XIV. Versatility: Hydraulic C-clamps are used in a wide range of applications, including welding, metal, fabrication, woodworking, automotive repairs, and industrial manufacturing.

## PROBLEM STATEMENT

This project is intended to design and manufacture a hydraulic c clamp, where the top plate of LEFT BEAM or RIGHT BEAM beam is pressed by applying hydraulic pressure and remove mismatch of Butt joint of top plate of traction and middle beam will be done properly. The c clamp is to be fitted in such order that the tacking can be done properly. The project is very important to the industry as through understanding the characteristics of manual effort, failure, time and money will be saved. This is also very important from the safety perspective as this will lead to a safe operating environment for operator.

## OBJECTIVES

The main objectives of this project are:

1. To design a semi-automated pressing machine or hydraulic c clamp that can align the top plate.
2. To replace the use of manual hammering for tacking operation.
3. To fabricate a semi-automated pressing machine or hydraulic c clamp that can help workers in hammering processes.
4. To increase the efficiency and accuracy of the correcting mismatch operation.

The objective of this research is to design a semiautomatic hydraulic c clamp based on the creativity techniques for the special-purpose. It also provides a better control which are operated by mechanically or electronically for pressing operation in upward and downward direction. An innovative concept of two in one facility has been conceived and being implemented. The research includes the integration that hydraulic clamps offer an easy and effective way to perform pressing processes. They are mechanical devices that use some type of liquid, such as oil, to clamp a workpiece with pressure. While all hydraulic clamps are designed for pressing processes, they are available in different types.

The design of hydraulic c-clamp is completely based on the creative problem-solving process which includes following eight

- Analysing the environment
- Recognizing a problem
- Identifying the problem
- Making assumptions
- Generating alternatives
- Choosing among alternatives
- Implementing the chosen solution

- Control & safety

#### PROJECT SPECIFICATION

The most reliable design of semiautomatic hydraulic c-clamp is described below along with their specification in order to show the different existing approaches to the small and portable pressing concept. These data could be useful when performing the initial sizing in the design stage of the hydraulic c-clamp project.

#### Marketing features:

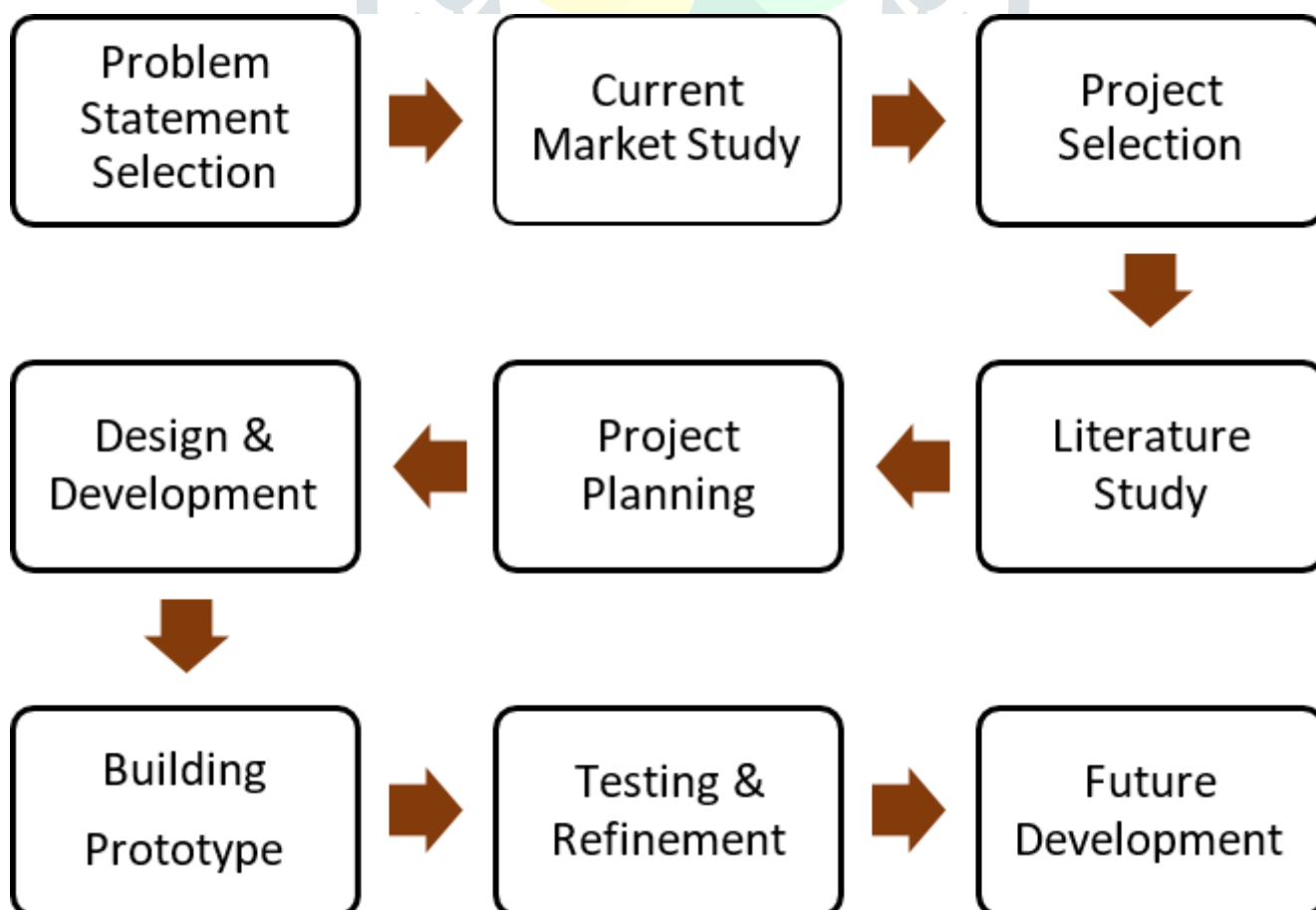
##### Locally:

- Increase profits
- Increase production
- Reduce cost
- Increase safety
- Realize manpower

##### Globally and internationally:

- Raise the economy
- Accuracy in international manufacturing
- Increase in the international industrialization
- Fast completion in global manufacturing

#### FLOW CHART



## HYDRAULIC CLAMP FABRICATION

A hydraulic C-clamp is a type of clamp that uses hydraulic pressure to create clamping force. It is made up of a C shaped frame, piston, and a hydraulic cylinder when the hydraulic pressure is applied to the cylinder, the piston moves which causes the frame to close. The clamping force is created by the pressure of the hydraulic fluid. The basic working principle of hydraulic c-clamp use of hydraulic fluid and piston to generate and control the clamping force.

Here is the step-by- step breakdown of how it typically works:

- **Construction:** A hydraulic c-clamp consist of a c-shaped or body, which provides the structure and support for the clamping action. Inside the frame there is a movable piston assembly fixed plate.
- **Hydraulic system:** The clamp is connected to a hydraulic system, which includes a hydraulic pump, hydraulic pump reservoir, and hydraulic lines. The hydraulic pump generates pressure by forcing hydraulic fluid into the system.
- We are using this hydraulic C-clamp at Final tacking station of locomotive subassembly fabrication department where fabrication of subassembly of locomotive frame is to be carried out. Truck frame of locomotive subassembly contents 5 types of beams i.e., LH beam, RH beam, Middle beam, traction beam, End beam which are assemble to only tacking the subassembly with the help of welding process whenever we insert the all beam together for tacking purposed, while performing final tacking set up there is gap between top plate of LH beam or RH beam and middle beam and traction beam. To reduce these gaps by hammering to match the butt joint before welding, employees facing discomfort due to pain in neck, wrist, elbow, back, shoulder, forearms etc. with 39# ergo risks. If there is gap of coordination between 2 employees, this can result in major body injury like fingers pinch, finger crush (due to weight lift) and lower back injury.
- We are using hydraulic C-clamp with the help of overhead crane and fixed it at the point of mismatch the fixed plate of hydraulic cylinder takes support of bottom plate of beam.
- **Applying pressure:** When the hydraulic system is activated, the pump starts to push hydraulic fluid into the cylinder behind the piston. As the fluid pressure increases it acts on the piston, causing it to move forward towards the fixed plate and movable piston gives pressure of 1Ton on top plate of LH or Rh beam
- **Clamping action:** As the piston moves forward it pushes against the object to be clamp, while fixed plate provide the opposing force. The clamping force is directly proportional to the hydraulic pressure applied and the surface area of the piston and remove the mismatch or gap between them after removing the mismatch the top plate is tacked with the help of welding process.
- **Release:** When the clamping operation and tacking of frame is complete, the hydraulic pressure is released by a switching of hydraulic pump. The hydraulic fluid return to reservoir, and the piston retracts, allowing the object to be unclamped.



### DESIGN CONSTRAINS ENGINEERING STANDARDS

- quality features of hand hammers
- characteristics and verification
- Applies to hammers used under normal working
- Best practices established by experts in the industry
- Comply with laws that specify design and testing criteria
- Reduce product liability risk
- Budget for certification testing

### PROJECT BACKGROUND

A hydraulic press is a machine press using a hydraulic cylinder to generate a compressive force. It uses the hydraulic equivalent of a mechanical lever, and was also known as a Bramah press after the inventor, Joseph Bramah, of England. He invented and was issued a patent on this press in 1795. As Bramah (who is also known for his development of the flush toilet) installed toilets, he studied the existing literature on the motion of fluids and put this knowledge into the development of the press.

The hydraulic press depends on Pascal's principle-the pressure throughout a closed system is constant. One part of the system is a piston acting as a pump, with a modest mechanical force acting on a small cross-sectional area; the other part is a piston with a larger area which generates a correspondingly large mechanical force. Only small- diameter tubing (which more easily resists pressure) is needed if the pump is separated from the press cylinder.

## HYDRAULIC HOSE

A hydraulic hose is a flexible tube used to transport hydraulic fluid between hydraulic components, such as hydraulic cylinders, valves, pumps, and actuators, in a hydraulic system. It serves as a vital link for transmitting hydraulic power and allowing the controlled flow of fluid under high pressure



## HYDRAULIC CYLINDER

A hydraulic cylinder is a mechanical actuator that converts hydraulic energy into linear force and motion. It is a crucial component in hydraulic systems and is widely used in various applications, including construction equipment, manufacturing machinery, agricultural machinery, and mobile equipment.

**ONCLUSION**  
The Hydraulic C-clamp has been successfully designed. Functioning of the same has been confirmed by pressing and found working as per requirements. Automation of process has been developed successfully and tested to reduce the human effort in the operation with the help of hydraulic C-Clamp. Throughout the project, several key objectives were achieved. The design of the hydraulic C-clamp focused on durability, efficiency, and user-friendliness. By utilizing high-quality materials and implementing innovative engineering techniques, the clamp is able to withstand heavy loads and provide consistent performance. The project also involved extensive testing and validation procedures to ensure the reliability and performance of the hydraulic C-clamp. Rigorous testing verified its ability to withstand varying loads, extreme temperatures, and prolonged usage. These tests confirmed that the clamp consistently delivered the intended clamping force and maintained its structural integrity. Overall, the hydraulic C-clamp project has successfully developed a powerful, versatile, and user-friendly tool that provides significant advantages over traditional mechanical C-clamps. Its durability, precision, safety features, and cost-effectiveness make it a valuable asset for industry. The hydraulic C-clamp has the potential to revolutionize clamping operations and contribute to increased efficiency and productivity in industry.

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