International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

Design and Development of Compact Hydraulic Straightening Machine

Soham Karpe [1], Chetan Bhagat[2], Rishikesh Deshmukh[3], Shubham Shinde[4]

[1]Student & Washim
[2]Student & Pune
[3]Student & Khamgoan
[4]Student & Pune

Abstract - *In the manufacturing of the small spline shaft in the on cold rolling machine, due to continuous machining, the tool which is used to manufacture the spline shaft called as rack is wear out of the profile and the rack is damaged, thus it is important to form original profile on the rack. To maintain the height between the tool and the work piece, the spacer is used to support the tool and maintain the height. They remove the upper profile of the rack and to form new profile as to compensate for the height reduction of rack, we attached the new spacer of the varying height to maintain the constant height. The spacer is stressed due to various type of forces applied on it and get bended at different location with different magnitude varying from 50 micron to 500 micron and sometime during the manufacturing of the spacer the spacer may get bend due to operation like drilling, milling etc.. Due to bending of the spacer the additional stresses are developed in the tool i.e rack and profile on the spline shaft is may error. So, it is important to remove the bending in the spacer. For this we are manufacturing the special purpose machine to remove the bending of the spacer.*

***Key Words*: Cold Rolling Machine, Spacer, Spline Shaft, Special Purpose Machine.**

1. INTRODUCTION

A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. It uses the hydraulic equivalent of a mechanical lever. Unlike their mechanical counter parts, hydraulic press machines can compress any material to a full extent. Also, hydraulic presses take only half of the space that the mechanical ones take because they have the ability to compress a large pressure in a cylinder having a less diameter. Hydraulic presses are commonly used for forging, clinching, molding, punching, deep drawing, and metal forming operations. With the growth and importance of light-weighting in the aerospace and automotive industry, more applications are present in Thermoplastics, Composites, RTM Resin Transfer Molding, GMT Glass Mat Transfer and Carbon Fiber Molding. All of these applications require precise control and repeat-ability.

In the market different types of presses are available according to their capacity, direction of application of force, frame of the press and application. The mechanism or system which produce the mechanical force by using the oil as a working fluid we called it hydraulic machine. If the machine is uses for applying pressure it will be hydraulic press. Thus the hydraulic Jack is one of the hydraulic press, the jack normally used to lift the heavy vehicle. In this project we are using the jack to produce the mechanical force for the operation. The main purpose to using the jack is the cost reduction and availability of the jack in different capacity. Spacer are available in different size and width, thus the machine which we are designing should be applicable to all type of space. The material of the spacer is C-40 which is one of the type of carbon steel. Thus the main purpose of the special purpose machine is removing the bend of the spacer by using the hydraulic jack as the work producing component.

1.1 LITERATURE SURVEY

1. ANKIT H PARMAR, KINNARRAJ P ZALA, ANKIT R PATEL

Find that of structure optimization is to decrease total mass of hydraulic press while assuring adequate stiffness. Structural optimization tools and computer simulations have gained the paramount importance in industrial applications as a result of innovative designs, reduced weight and cost effective products. A method of structure optimization for hydraulic press is proposed in order to reduce mass while assuring adequate stiffness. Key geometric parameters of plates which have relatively larger impacts on mass and stiffness are extracted as design variables. In order to research relationship between stiffness, mass and design variables, common batch file is built by CREO and analysis is done in ANSYS. Top plate, movable plate and column design and analysis done.

2. MEHMET AYDIN, YASIN KISIOGLU

In this study, a suitable hydraulic press having four-column is designed and the stress distribution is calculated using both analytical and finite element methods under different loading conditions. Three different loading types, axial, eccentric and oblique, are considered in design process. Six

different types of standard sections having the same cross-sectional area are used for the press columns. Three different models for the press head are designed to hold the hydraulic cylinder. Therefore, eighteen different design combinations for a hydraulic press are modeled under three different loading conditions. Their stress distributions are calculated using a computer-aided finite element analysis (FEA) tool and analytical formulas and the obtained results are compared. Two different types of finite elements, shell and beam, are used for the modeling processes. Based on the obtained results, the best model for the hydraulic press considering the head and body types is defined.

3. TEJAS PATEL, VIKAS PANCHAL, SAURIN SHETH, PURVI CHAUHAN

Research that the integrate the mechanical system of hydraulic press with hydraulic system to facilitate the ease of operation to manufacture the smaller parts in a bulk. In the present scenario, time constrain is a crucial part for completion of any production process. Thus with the aid of atomization, the production time can be reduced as well as higher degree of accuracy can be achieved as the human efforts will be alleviated. Thus an attempt has been made to provide the smooth and rapid functioning of press work with the help of hydraulic system.

4. MR. K.SHRAVAN KUMAR1, B.PRASHANTH

In this project press frame and cylinder are designed by design procedure. The frame and cylinder are modeled by using modeling software CATIA. Using the optimum resources possible in designing the hydraulic press components can effect reduction in the cost by optimizing the weight of material utilized for building the structure. An attempt has been made in this direction to reduce the volume of material. So in this paper consideration for an industrial application consisting of mass minimization of H frame type hydraulic press.

2. PROBLEM STATEMENT

There is the formation of the bending in spacer at different location due to a different type of reasons. The bending of spacer may trouble other operation. To remove the bending of the space, send the spacer to other industries which increases cost. As company send their spacer to their vendor this increase their cost and time and company is willing to start there in house production so there is need of hydraulic press to remove bending from spacer also design should be made such that it does not require special operator on press and cost of hydraulic press should be less as possible. The bending should be completely removed to make spacer accurate and straight. To remove any deflection from spacer the machines should be highly capable and tough.

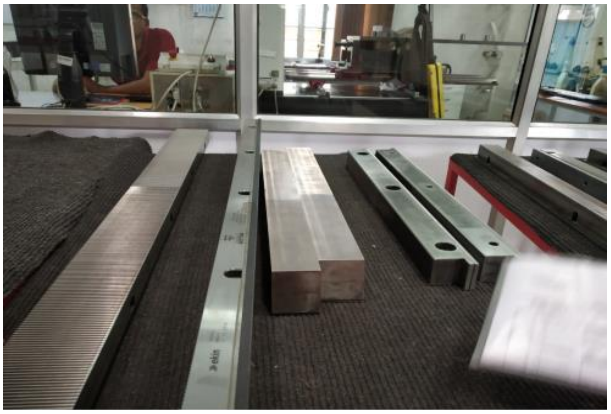


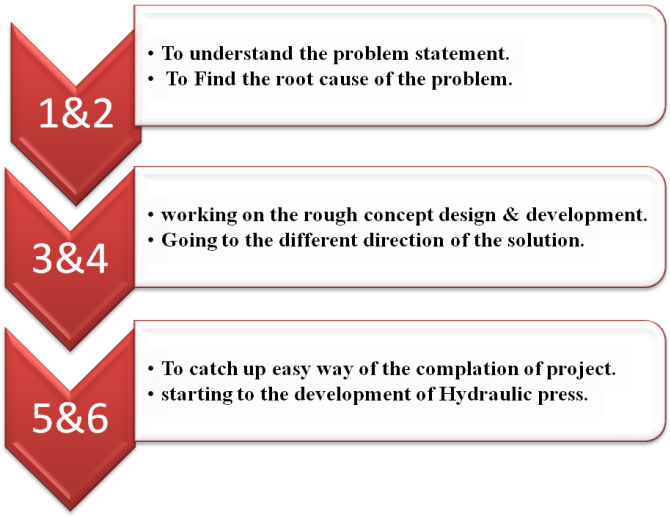
Fig-1: Spacers with Rack Tool

2.1 OBJECTIVE

- Analysis the force which is required for bending of spacer.
- To design the components of the hydraulic press using geometric modeling software.
- To analyze and optimize the critical areas of the hydraulic press.
- To finalize the design of hydraulic bending removal press.
- Analyze the design assembly and parts in ANSYS software.
- To manufacture the hydraulic bending removal press machine.
- To carry out final analysis where the deflection and bending takes part in spacer is determined by the mechanism and whether the machine is capable for the operation.

2.2 METHODOLOGY

This innovative project is smart after completed the design and fabrication of the machine, but now it is very challenge full because it needs gather information from internet, manufacturing sectors and bending machine users. The methodology flow diagram of this project is shown below.



In achieving the aim of this work, component parts of the machine were designed using various design equations. The design results were used to select materials for various components. The detailed drawing of the developed hydraulic press machine was done using CATIA software. In fabricating the machine, mild steel was used as the locally material. The use of mild steel is due to the fact that its strength, rigidity and mach inability falls within the design specifications. It is also available and cost effective.

3.0 DESIGN

The basic design of the machine as shown in the fig. Where the hydraulic jack is main part of the machine. Which produce the mechanical force required for the operation.

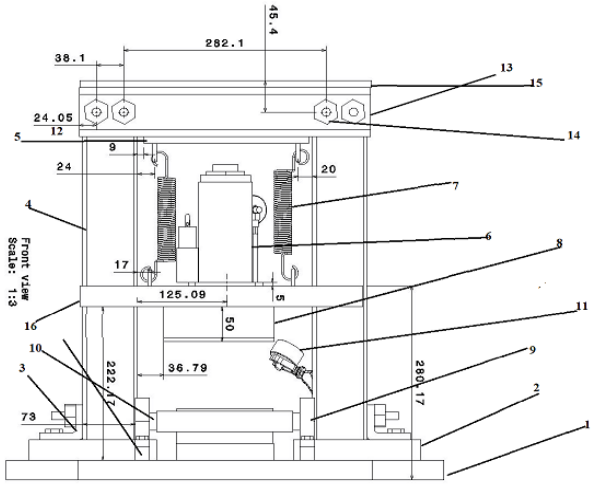


Fig-2: Developed Design of Machine

3.1 CALCULATION OF THE FORCE:-

In the design and development of any machine. We should know the essential parameter of the machine. In this machine the essential parameter is the force. How much force is required to remove the bending of the spacer?

3.1.1 Theoretical Calculation:-

Assuming that the spacer is supported between the two support load is applied at the center by the punch. Thus the structure will be like simple supported bead with point load at center. As shown in fig.

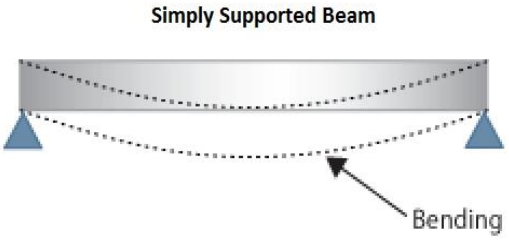


Fig 3:- Simply Supported beam

X Ton=78.75/9.81=**8.02 ton**.

3.1.2 Practical Calculation:-

when we test the spacer under the Universal testing machine, we get force 9KN for area 36*12mm.for maximum material conditions the area of max size spacer is 9 time greater than our tested spacer so force must be 9 time.

i.e 9*9=81 KN
convert into ton we get,

x ton=81000/9810=**8.25 ton.**

By the both calculation, we conclude that the maximum size of the jack to be needed to remove the bending of the spacer by considering safer side is **10 ton.**

3.2 DESIGN OF DIFFERENT PART:-

The main components which may be fall during the working operation are side pillar and upper column.

3.2.1 Side Pillar:-

The compressive stress induces in the side pillar of the system. The induce compressive stress should be less than the permissible stress (assume 250N/mm^20).

Stress induce in the side pillar,

Stress=force/ area

=10*9180/76.2^2-56.3^2

=38 N/mm^2

Thus the induce stress is less than permissible stress, **so design is safe.**

3.2.2 UPPER BOLT:-

The upper bolt (4 M 12 bolt) between the upper column and the side pillar may fail due to shearing stress.

Stress produce in the bolt is,

= Shearing force/area

= 10*9810/113.08

=250N*mm^2

The induced stress is less than the permissible stress, **so design is safe.**

3.2.3 UPPER COLUMN:-

The upper column is subjected the central force due to jack pressure, the total force which is act on the spacer to remove the bending same force is act on the upper two column. Thus it is necessary to check the upper column. The theoretical calculation of the column will not give the accurate result. Thus we tested the upper column under the Ansys program where we apply the load on the centre of the upper column. Which practically apply by the hydraulic jack during the operation.

3.3 ANSYS ANALYSIS:-.

From ANSYS analysis we get analysis that upper column sustain the load of 10 to 20 to load there is slight deformation on upper column due to hydraulic jack but it can sustain the load of 20 ton and the normal reaction from opposite side so that the column and bolt does not come out while intensive bending of spacer.

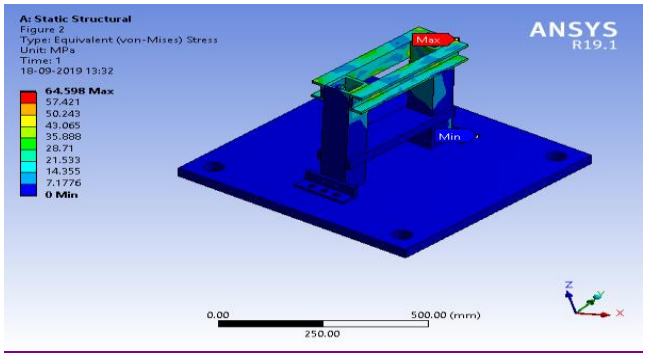


Fig-4:- Equivalent Stress

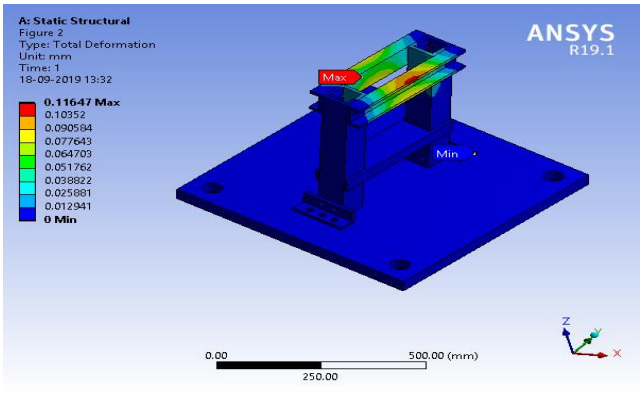


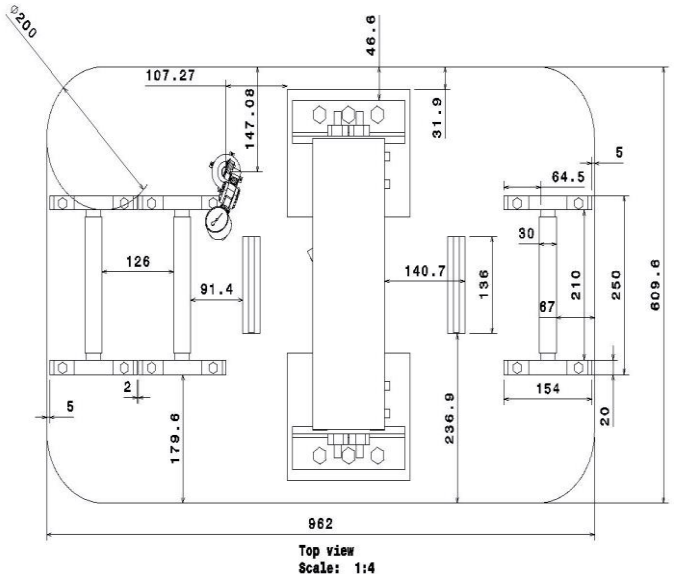
Fig-5:- Total Deformation

4.0 DETAILS OF THE COMPONANT

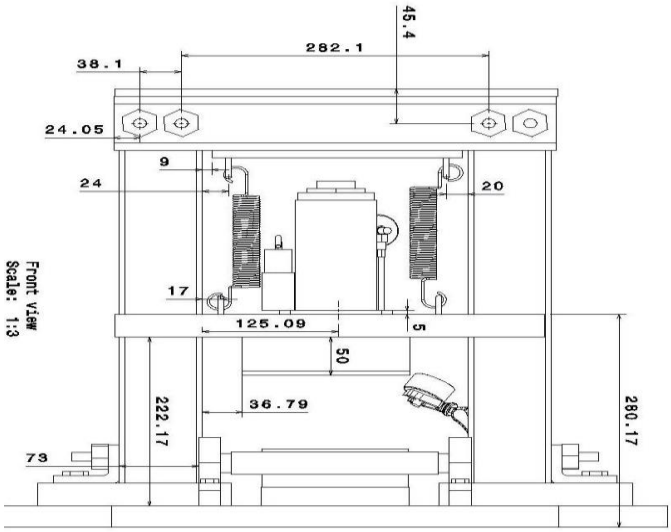
SR.NO.	Name of Parts	Material
1	Base	Mild steel
2	Movable plate	Mild steel
3	Spring	Mild steel
4	Upper plate	Mild steel
5	Jack	Mild steel
6	Side pillar	Cast iron
7	Die	Mild steel (Case hardened)
8	Punch	Mild steel (Case hardened)
9	Frame	Mild steel

Table 1- Details of the Components

5.0 DRAFTING OF THE ASSEMBLY: -



Top View



Front View

Fig-6: Drafting of the Model

6.0 CATIA MODEL OF THE ASSEMBLY:-

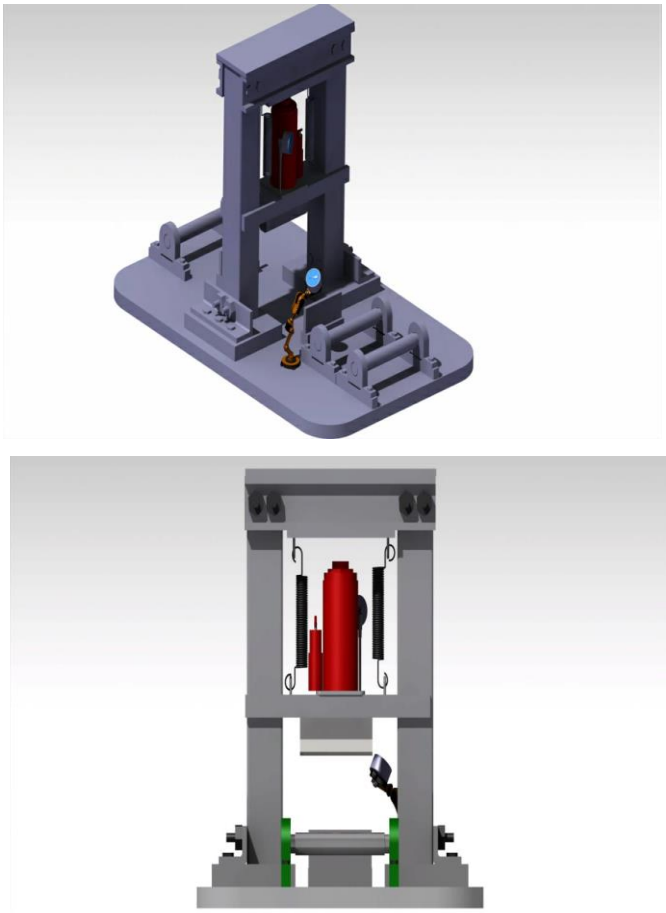


Fig-7:- Catia Model of the Assembly

7.0 WORKING:-

In machine used the simple concept of the simple support beam to remove the bending in the spacer. Initially the spacer one tip is kept on the first rolling shaft and moved in the another shaft, due to rolling action of the rolling shaft which is supported by the bearing the force require to move the heavy weight spacer over the working bead is easy. The tip of the dial gauge is kept on the spacer during the rolling action. The dial gauge gives the ideal about the location of the bending and the magnitude of the deflection present in the shaft with and accuracy up to 20 micron. The bended portion is supported in between the two supports as shown in the fig. The support distance is mange according to the magnitude and location of the deflection. Then the operator operates the single acting hydraulic jack by reciprocating the lever of the jack. The jack piston moves upper and the punch which is attached to the swinging plate moves vertically with the support of the upper pillar. The punch exert the force on the spacer at the location of the bending causes the plastic deformation of the spacer. The amount of the pressure

produce in the jack is displaced by the pressure gauge with the pressure range of 0-700 bar. During the operation the spring back on the spacers is consider and the spacer deflected extra in the opposite direction the bending direction. When the bending stroke of the jack is done and operator opens the return valve of the jack. Due to the spring force the punch to the initial position with the swinging plate. The straightening of the spacer again check with the dial gauge by simple rolling the spacer on the roller, if the spacer is straight with according to the permissible limit if not repeat the above procedure. Due to identical spacer and the amount of the deflection the operator get an ideal about the force should apply on the spacer by the punch with the help of pressure gauge.

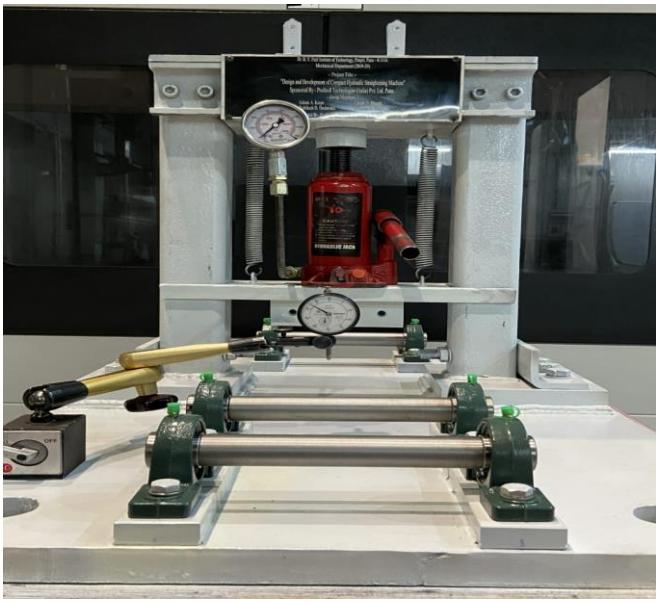


Fig-8: Actual Project

8.0 CONCLUSION:

We Come to the conclusion that both the valve of tonnage of for approximate same i.e. 8.5 ton but considering maximum material condition and the elastic recovery of the material due to its elastic property **10 ton** hydraulic cylinder is best for the system. It is a multi-purpose machine as it can be used for performing different tasks. By changing the die different operation like bending, blanking etc. can be performed on a hydraulic press machine. The design has main focus on reducing operator fatigue and increase safety, improving the flexibility and makes operation more convenient, and to achieve dimensional and positional accuracy. Components of press are designed to avoid bending failure due to applied load. Mild steel is selected as material based on its properties such as high bending & tensile strength, it compatibility with operation like machining, welding, finishing, cutting etc. and cost as economic factor. Dimensional and positional accuracy. Components of press are designed to avoid bending failure due to applied load. The manual approach is used to minimize cost and unskilled operator call handles it.

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10.0 BIOGRAPHY:-

Name: Soham Karpe
Student of Mechanical Engineering
From DR. D. Y. Patil Institute of Technology Pimpri-18.

Name: Chetan Bhagat
Student of Mechanical Engineering
From DR. D. Y. Patil Institute of Technology Pimpri-18.

Name: Rishikesh Deshmukh
Student of Mechanical Engineering
From DR. D. Y. Patil Institute of Technology Pimpri-18.

Name: Shubham Shinde
Student of Mechanical Engineering
From DR. D. Y. Patil Institute of Technology Pimpri-18.