

# “DESIGN FOR MANUFACTURING AND ASSEMBLY OF STAPLER CUM PUNCHING MACHINE”

Rahul Mhetre<sup>1</sup>, Abhijit Jamdade<sup>2</sup>, Swapnil Hagare<sup>3</sup>, Sachin Kumbhar<sup>4</sup>  
Under Graduate Student, S.M.S.M.P.I.T.R.AKLJ.  
Mr. Amir K. Deshmukh<sup>5</sup>  
<sup>5</sup>Assistant Professor, S.M.S.M.P.I.T.R.AKLJ.

**Abstract:** Nowadays largely used office tools, such as stapler and punching machine in government office, business, schools and Xerox shops. Expect these office tool have to be compact and easy to handle. Generally stapler and punching machine is used according to number of pages to be staple and punch. Also for center staple and punch different stapler and punching machine is needed. Keeping different size stapler is not handy for us. In this research paper the project model which consist of multisize pins stapler with center staple and punching machine with automatic center in a one single product. Due to compactness of this product cost reduces as well as it is simple to handle and use. In this project two separate operation done i.e. staple and punching operation in a single product.

**Keywords:** DFMA, Multisize Pins, Stapler, Punching.

## 1. INTRODUCTION

In today's world as we know its era of automation, digitalization as well as people adopting new different methods of working which simplify the work. In our day to days life we use different kinds of machines such as stapler, punching Which is generally used in many fields means in colleges, offices, industries, government ,homes, hospitals and many other field. The stapler and punching is become very essential for office work. The function of stapler is to join the bunch of papers by means of stapler pin, on the other hand as stapler is very essential, punching is also plays a key role. It is very useful while making file.

A stapler is a mechanical device made for different uses and in many different sizes. It is being used to join two or more things, such as papers, tissues or parts together by driving a thin metal staple through them. There are two main types of paper staplers, manual and electric. Manual staplers are normally hand operated, electric staplers are available in variety of different designs and models. Their primary function is to join large number of papers together in rapid succession. The average lifespan of paper staplers is about 5 to 8 years.

A hole punch or paper puncher or punching machine is a common office tool which is used to create holes in sheets of paper, often for the purpose of collecting the sheets in a binder or folder. In nowadays there are different types of paper punch are available which are classified as single hole paper punch, double hole paper punch as well as multiple hole paper punch. But generally most commonly used is double hole paper punch.

People are doing most of his work with the help of tools, gadgets, and appliances. Multifunctional tools are being developed to integrates these tools and thus reduce the number of tools in the working environment. In multifunctional tools, more functions come together and combine their power into single product. The several advantages of multifunctional tools which reduces material handling time and cost of the product. This study aims at developing concepts for a multifunctional tool which can perform the functions of both the stapler and the punch.

The DFMA of stapler cum punching machine consist of two different size staplers and one punching machine which is placed on base plate. The project which can perform four functions such as small pin staple, medium pin staple, punching with automatic center and staple the pin at the center of page. The whole advantage of this project is that it performs multiple functions and this combine multifunctional product is not available in the market with minimum cost.

## 2. DFMA

Design for Manufacturing and Assembly (DFMA) means the combination of two methodologies; Design for Manufacture (DFM) which means the design for easy to manufacture the parts that will form a product, and Design for Assembly (DFA), which means the design of project for easy to manufacture. It tends to reduce overall parts in product with effective design process. Also it gives simplified product structure due to that cost of product get reduced. In this proposed project some parts being reduced such as springs, rivets, stapler base, metal hand, etc. The assembly process is simplified i.e. as number of parts required are less, so time required for assembly of model is less as compared to original products. DFMA makes the automation easier. By reducing the complexity of the product, the potential for operator error is reduced, improving process capability and improving the quality of product.

## 3. COMPUTATIONAL MODELLING AND SIMULATION

### 3.1 Computational Modelling

The CATIA V5 Standards define defaults value for the element properties in CATIA. It is an important tool for manufacturing a component and design field along with the ANSYS. Modelling of following product consist of part design, surface design and assembly design with their commands.

Following are the CATIA drawing of the project model.

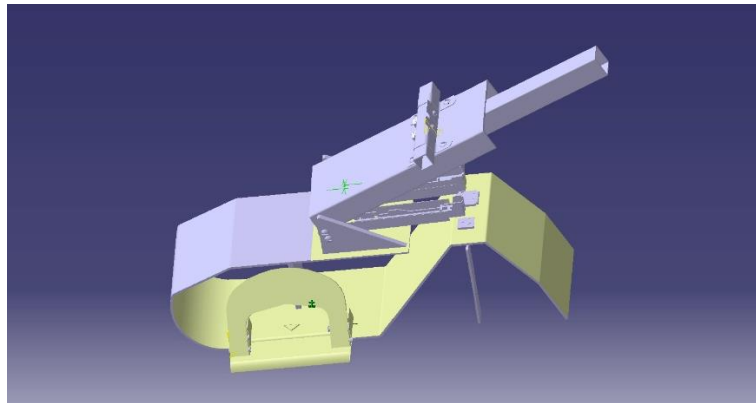


Fig.3.1. Right Hand Side View of Product

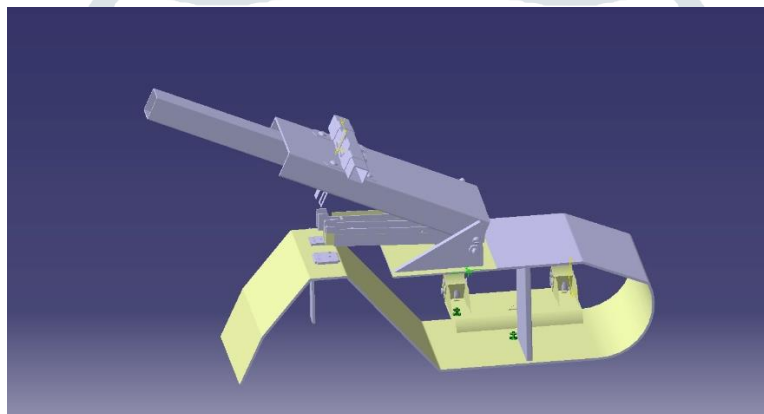


Fig.3.2. Left Hand Side View of Product

### 3.2 Simulation

After the modeling of project model in CATIA-V5 it's necessary to analyze the project model in ANSYS. The ANSYS software help to achieve innovative, reliable and high quality product. In this the structural analysis of base plate is done which contains the values of stresses and portion at which the large stress is act i.e. failure of parts for the given forces values.

#### i. Meshing

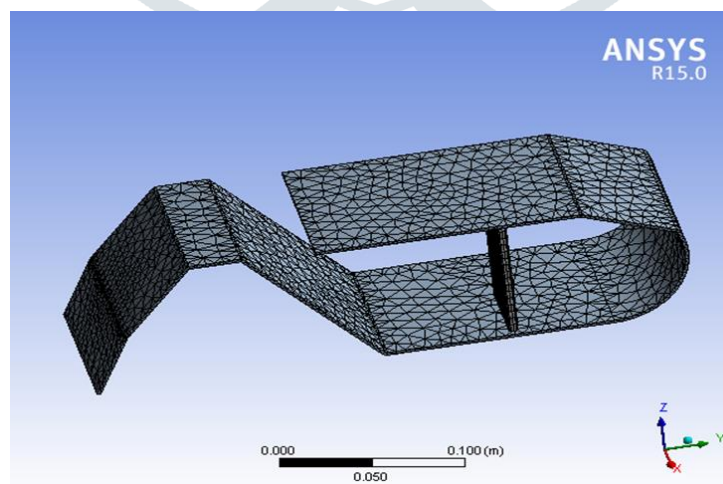


Fig.3.3 Meshing of Base Plate

The above fig 3.3 shows the meshing of base plate. In this meshing the relevance center size is fine for more accurate result. Smoothing of meshing is medium. After that the one support is fixed and force (100N) is applied at top of the base plate.

## ii. Solved Geometry

The below fig (3.4 and 3.5) shows the analysis result of base plate. In that the two different stresses values are calculated such as normal stress value and Equivalent (von-Mises) stress value.

The selected 2 mm thickness base plate is able to sustain a load of 100N without failure. As shown in fig 3.4 maximum Normal stress is acting at the supported portion i.e.  $3.2522e7$  N/m<sup>2</sup> or  $32.522$  N/mm<sup>2</sup> the maximum stress area is minimum.

As shown in fig 3.5 Equivalent (von-Mises) stress is acting at the supported portion i.e.  $9.5452e7$  or  $95.452$  N/mm<sup>2</sup> there is no maximum stress area.

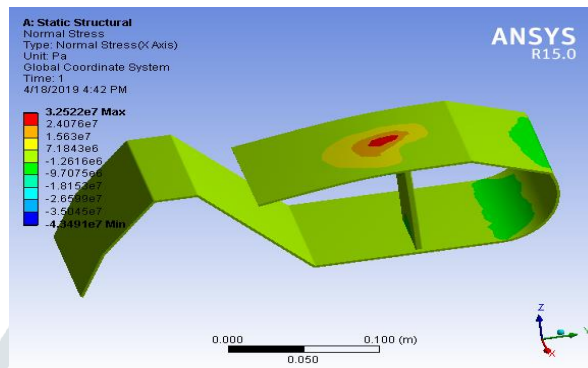


Fig.3.4. Normal Stress

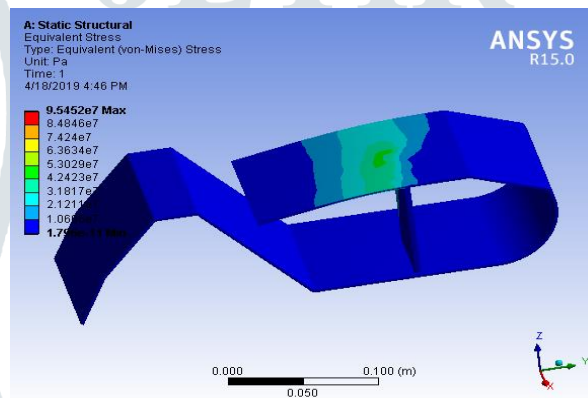


Fig.3.5. Equivalent (von-Mises) Stress

While doing analysis software gives the stresses value. That values are within the limit, so selected project design is safe.

## 4. MANUFACTURING AND ASSEMBLY

In that the total manufacturing of project model is done from some raw material, purchased parts and some of the manufactured parts. Also at the time of the manufacturing the various operations are performed such as cutting, bending, welding, drilling, grinding, etc. with the help of machines such as cutter, vice jaw, welding machine, radial drilling machine, grinder, etc. Finally assembly is done with the help of nut bolt. The below fig 4.1 shows the assembly of project.



Fig.4.1. Assembly of Project

## 5. COMPARISON AND RESULT

### 5.1 Comparison

#### Conventional Stapler

- i. Conventional staplers is not multifunctional.
- ii. Conventional staplers is having different varieties and different sizes of pin as well as for center stapling is done with the help of center stapler.
- iii. It consist of more parts, so cost is high and it take more time for assembly.
- iv. As it is not multifunctional due to that it offers more handling of different staplers.

#### Modified Stapler

- i. Proposed project stapler is multifunctional.
- ii. This stapler consist of all the varieties in single stapler i.e. small pin size stapler, medium pin size stapler with center staple.
- iii. Due to DFMA concept it consist of less parts, so cost is less and it take less time for assembly.
- iv. As it is multifunctional it does many functions and due to combine product handling is easy.

### 5.2 Result

By seeing above comparison this kind of product is not available in the market which does many functions, so we made a project model which is a combination of two various sized staplers and one punching machine. By using DFMA concept we reduces overall cost by 30% to 40%.

## 6. ADVANTAGES AND DISADVANTAGES

### 6.1 Advantages

- i. The stapler can staple the two size pin in one stapler.
- ii. The stapler can staple the pin at the center of the pages.
- iii. Two operations perform in a single product i.e. staple and punching.
- iv. Punching does not required the center of page, it automatically take center of page for A4 size paper.
- v. It is compact in size.
- vi. The cost of the product is very less as compared to conventional stapler and punching.
- vii. It is easy to handle.
- viii. This product handle the all things related to stapling and punching limit up to 10-25 sheets.

### 6.2 Disadvantages

- i. There is no any collecting tray for the waste of paper at the time of punching.
- ii. The steel tooth is little bit flexible due to long length.

## 7. CONCLUSION

The project is totally based on DFMA concept. According to that concept some parts are reduced. So, the time required for assembly is less. By considering unavailability of product in the market, so this project is modified as hybrid of stapler and punching machine. It includes different functions which do their works in a single product such as small size pin staple, medium size pin staple, punching with automatic center and center staple. This is best combination of product by considering things as like analysis results, market survey.

With this modification of project it conclude that finding of less expensive parts of product is the necessity of current situation in offices, Xerox shops, colleges etc. This project having less manufacturing cost as compared to conventional product.

## 8. FUTURE SCOPE

Further modifications in the design can be carried out on punching machine. The modification will be automatic center of different paper sizes. Also for simple design less part can be used. The waste collecting tray of punching machine can be added in future modification. The operating mechanism of stapler can be improved.

## 9. REFERENCES

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