To Study Design of Piercing Tool

Chetan B. Kawale [1], Ankush R. Daware[2], Anikit V. Thakare[3], Gokul B. Ajmire[4] , Prof. C. G. Deshmukh[5]
[1, 2, 3, 4] UG, [5]Assistant Professor, Mechanical Engineering Department, DES'sCOET, Maharashtra, India.

Abstract – The press tool life is major criteria in high volume production of sheet metal components. For a Progressive die, proper tool life and component accuracy are necessity for achieving higher productivity and low cost per component. In this study we are going to form a basis by accumulating factors for tool life selection and making data easily available for industrial designers. The data is based on old tool which was analyzed and its characteristics were studied closely and improvements were made which is a part of our project. The main aim of our study is to manufacture large number of components in less time. The press tool in this study will have a very short stoke. After making the press tool we will inspect the component and then finalize the tool for production. We will also record the data for cost estimation. Thus, factor selection is made easy by specific data made available and the usefulness of the system is demonstrated by sample run of press tool design. It caters for obtaining the final components conforming to required dimensions and standards.

Index Terms – Press tool, Progressive die, Sheet metal, Tool life.

1. INTRODUCTION

1.1 History:

When someone visits a modern production plant, views the press department as an assemblage of noisy mechanical "monsters" calmly chopping out parts from a roll of metal strip, But he never realizes that this department plays an extremely important role in our domestic life, being largely responsible for many of the comforts and amenities which have been brought within the reach of all classes, Presses and presswork technique is widely used in industry mainly during the more recent years, This is because it is a rapid, an accurate, and an economical method of articles production from sheet metal at very high production rates with either unskilled or semi-skilled labour, Therefore the results are a very considerable saving in both material and labour and in most cases an article pleasing in appearance, Some of the operations done in this department are: blanking, piercing, lancing, cutting off and parting, notching, shaving, bending, forming, drawing etc, Usually combinations of these operations are used because by this method time is saved therefore the production cost of the article is decreased, Finally combination of two of these operations will be used during this project since it's objective is todesigna press tool for blanking and piercing of a component(a mounting plate of a filter)

1.2 Objective of Study:

- Design tool to maintain precision accuracy of the component produced.
- Select the material that increases the tool life.
- To study the forces required for press tool.
- To increase productivity.

1.3 Scope of Study:

- It has scope in various machining industries.
- This study can help for producing tool.

1.4 Benefits from Study:

The benefit from these study is reducing process time. The tonnage required for the press tool calculation.

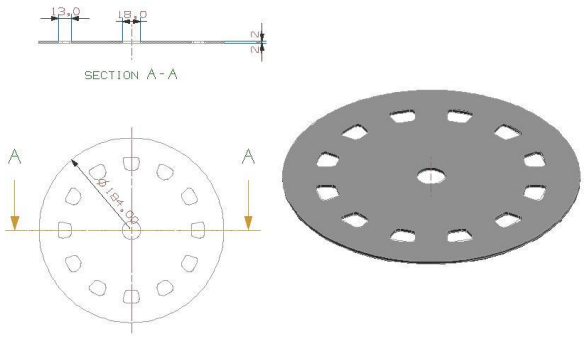
2. DESIGN ACTIVITY

- The file are divided into 7section by separator
- Every section have its own importance

2.1 Separator 1: Design and Development Input:

- Product drawing and 3D model
- Technical data input for design
- Product process
- Reference drawing

a) Product drawing and 3D model:



2D Drawing of Component
3D Drawing of Component

Fig. 2.1: Component Drawing

A component or part drawing is termed as a production drawing, if it facilities its manufacture. It is an authorized

document to produce the component in the shop floor. It furnishes all dimensions, limits and special finishing processes such as heat treatment, grinding, etc., in addition to the material used. It should also mention the number of parts that are required for making of the assembled unit, which of the part is a member.

b) Technical data input for design:

Press tool data

Material	: -	SD 70C
Thickness	: -	2.18 mm.
Width * diameter	: -	Ø184 * 2.18
Type of feed	: -	Manual
Press	: -	100T
Tonnage	: -	84T
Shut height	: -	325.6
Spring travel (stripper)	:-	4.6 mm.
Spring travel (dia.)	:-	26 mm.
Punches in stripper/inserts	: -	12

c) Product process:

The process consists of the following stages

i) Coming up with a product idea:

Product idea or Idea screening criteria are used to determine compatibility with overall business objectives and whether the idea would offer a viable return on investment.

ii) Researching the Idea:

The type of information you'll be gathering depends on the type of product or service you want to sell as well as your overall research goals. You can use A process used to evaluate innovative product ideas, strategies and marketing your research to determine a potential market, to size up the competition, or to test the usefulness and positioning of your product or service.

iii) Designing and planning:

Product design as a verb is to create a new product to be sold by a business to its customers.A very broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new products.

Product design process: the set of strategic and tactical activities, from idea generation to commercialization, used to create a product design. In a systematic approach, product designers conceptualize and evaluate ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products that people can use.

iv) Implementing:

Implementation as “a specific set of activities designed to put into practice an activity or program” (Fixsen, Naoom, Blasé, Friedman, & Wallace, 2005, p. NIRN has researched program implementation across disciplines, including social services, business, engineering, and education, providing a broad overview of the challenges and facilitators. Its review highlights major problems in implementation practice, such as relying solely on implementation “by edict” or training alone, or implementing a new intervention without fidelity, without a broad enough scale to effect change, or without a plan for sustainability.

v) Monitoring :

The monitoring of products and services in any country is essential to ensure that all consumers get the quality, satisfaction and maximum benefits they need for money spent to acquire these products and services. This can only be achieved if there are established national monitoring mechanisms and systems in place to ensure that goods and services offered to consumers are of a level of quality that satisfies consumers’ need.

vi) Research:

Various stages of the design process (and even earlier) can involve a significant amount of time spent on locating information and research. Consideration should be given to the existing applicable literature, problems and successes associated with existing solutions, costs, and marketplace needs.

The source of information should be relevant, including existing solutions. Reverse engineering can be an effective technique if other solutions are available on the market. Other sources of information include the Internet, local libraries, available government documents, personal organizations, trade journals, vendor catalogs and individual expert available.

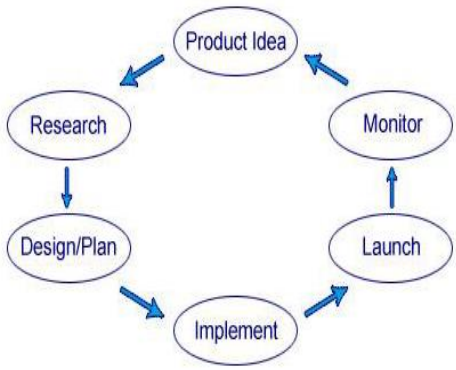


Figure 3.2 Product process

d) Reference drawing:

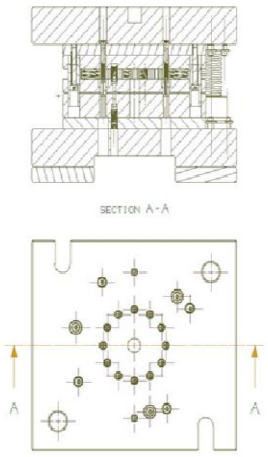


Figure3.3 Reference Drawing

2.2 Separator 2: Design Output Stage:

- All tentative drawing
- General assembly and bill of material

All tentative drawing:

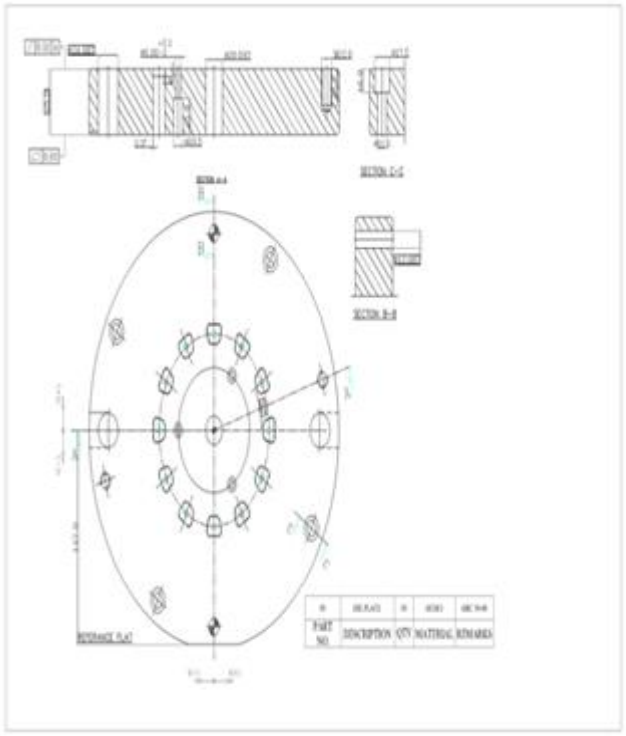
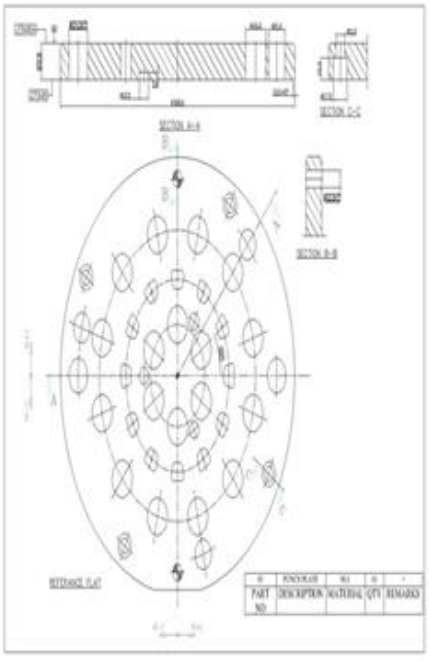


Figure 3.5 2D Drawing of Punch Plat



- General assembly and bill of material:

Bill of material or product structure (sometimes bill of material, BOMorassociatedlist) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an end product. A BOM may be used for communication between manufacturing partners, or confined to a single manufacturing plant. A bill of materials is often tied to a production order whose issuance ma generate reservations for components in the bill of materials that are in stock and requisitions for components that are not in stock.

A BOM can define products as they are designed (engineering bill of materials), as they are ordered (sales bill of materials), as they are built (manufacturing bill of materials), or as they are maintained (service bill of materials or pseudo bill of material). The different types of BOMs depend on the business need and use for which they are intended. In process industries, the BOM is also known as the formula, recipe, or ingredients list. The phrase "bill of material" (or BOM) is frequently used by engineers as an adjective to refer not to the literal bill, but to the current production configuration of a product, to distinguish it from modified or improved versions under study or in test.

In electronics, the BOM represents the list of components used on the printed wiring board or printed circuit board. Once the design of the circuit is completed, the BOM list is passed on to the PCB layout engineer as well as component engineer who will procure the components required for the design.

2.3 Separator 3: Design Review:

- Customer review
- Design internal review

i) Customer review:

A customer review is a review of a product or service made by a customer who has purchased the product or service. Customer reviews are a form of customer feedback one electronic commerce and online shopping sites. There are also dedicated reviews ites, some of which use customer reviews as well as or instead of professional reviews. The reviews may themselves be graded for usefulness or accuracy by other users.

The reliability of customer reviews has been questioned. Negative reviews by competitors, need to be policed by the review host site. Since few sites restrict users to reviewing only items purchased from that site, it is difficult to prove a customer has actually used the product they are reviewing.

ii) Design internal review:

The design review provides a forum in which questions can be answered, assumptions clarified and advice sought. They are a useful mechanism whereby the design of product can be optimized through a systematic review of and feedback on design process outputs. Typically a number of formal and informal reviews are conducted during the duration of a design project. These reviews may last a few hours or a few days depending on the scope and the phase of the project.

In general, design reviews facilitate communication between the design team, management and the customer. Management and the customer are provided insight into the technical status of the product while the design team receives valuable feedback on issues involving the design. The objectives of a design review are to ensure that all contributory factors and reasonable design options have been considered, and that the design meets the requirements as outlined in the Product Development Specification. The design team is responsible for providing an accurate, concise overview of the design to-date and the facilitation of productive discussions. Reviewers are responsible for assessing the design to ensure that it can be produced, tested, installed, operated and maintained in a manner that is acceptable to the customer. The key participants at a design review include the Chairperson, the design team, subject matter experts and, if applicable, the customer.

iii) Chairperson:

The chairperson is responsible for co-coordinating the preparations for the design review and managing the conduct of the review meeting. This person also has the responsibility of monitoring the follow through of any actions resulting from the meeting. There are two common approaches to this position. In some companies, the chairperson for a design review is a senior person with an engineering background and a solid understanding of the design process. Typically, this individual is not directly involved in the design project itself and therefore can remain objective. When a product is being developed for particular customer, co-chairpersons may be other is often the senior or principal employed. The customer supplies one chairperson whiles the engineer or the project manager for the project. This approach helps maintain balance and objectivity.

iv) Design Team:

The design team participates in the design review by providing details regarding the design and the design process and discussing and receiving feedback. It may not be practical to include the entire design team for large development projects therefore only the key persons involved in the preparation of the design review participate throughout the entire review.

v) Subject Matter Experts:

The selection of subject matter experts is dependent on the appropriateness for any individual project. These experts are not directly involved in the development of the design and may include representatives of the department.

2.4 Separator 4: Design Verification:

- The tool die is suitable for the specified machine
- The tool parts can be assemble easily
- The tool meet the specified requirement of customer
- Selection of material is suitable for tool
- The acceptance criteria and tool parameter are clearly define and documented.

i)The tool die is suitable for the specified machine:

Tool and die makers work primarily in tool room environments sometimes literally in one room but more often in an environment with flexible, semi permeable boundaries from production work. They are skilled artisans (craftspeople) who typically learn their trade through a combination of academic coursework and hands-on instruction, with a substantial period of on-the-job training that is functionally an apprenticeship (although usually not nominally today). Art and science (specifically, applied science) are thoroughly intermixed in their work, as they also are in engineering. Manufacturing engineers and tool and die makers often work in close consultation as part of a manufacturing engineering team.

ii) The tool parts can be assembling easily:

The tool assembly is built using several components. The component at the rear end must connect the machine tool, and the cutting component is found on the other end

(ex.drill or insert). Varying components are used intermediately (ex.: extension, collets) to reach the desired geometry. The assembly documentation describes how the components are assembled, to ensure that the applied geometry in the CAM system matches that of the real tools in the CNC machine.

- Header data contains information such as identification, a specific number and the allotted tool class.
- Geometric fields are computed directly through the data of the applied components. Adjustable tools (ex.: fine drill tools with adjustable diameter) are stored in addition to the assembly data.
- Assembly instructions contain the bill of material as well as the data for the parts assembly that is important for the specific assembly (ex.: adjusting tolerance + 0.03/- 0.01 mm).
- Nominal values for the presetting serve as a default in the measuring process with a tool presetting machine. The exact position of the tool and the measuring method can be specified, in addition to the nominal values of the geometry, so that, for example, the left or right corner has to be measured for a grooving tool.

iii) The tool meets the specified requirement of customer:

Customer satisfaction (often abbreviated as CSAT, more correctly CSat) is a term frequently used in marketing. It is a measure of how products and services supplied by a company meet or surpass customer expectation. Customer satisfaction is defined as "the number of customers, or percentage of total customers, whose reported experience with a firm, its products, or its services (ratings) exceeds specified satisfaction goals."

Within organizations, customer satisfaction ratings can have powerful effects. They focus employees on the importance of fulfilling customers' expectations. Furthermore, when these ratings dip, they warn of problems that can affect sales and profitability.... These metrics quantify an important dynamic. When a brand has loyal customers, it gains positive word-of-mouth marketing, which is both free and highly effective."

iv) Selection of material is suitable for the tool:

Products do not only discriminate from other products in functionality, but also in the way they please users. The sensorial properties of materials influence whether a product provides adequate feedback or gives a pleasant emotional experience. Designing a specific user-interaction involves selecting appropriate materials that create that interaction. However, defining which material properties contribute to the desired interaction is difficult as these are often subjective. Clients are not always able to clearly specify what desired user-interaction they want to create with the product.

The tools define the user-interaction via several means, namely pictures of product examples and their materials, actual materials samples, and the sensorial aspects of materials during several phases of the user-product interaction. This paper presents an evaluation of the tools with professionals and students. The results show that these tools lead to high consensus between product designers and clients during discussions and a better definition of the required materials properties.

v) Acceptance criteria and tool parameter are clearly defined and documented:

In engineering and its various sub disciplines, acceptance testing is a test conducted to determine if the requirements of a specification or contract are met. It may involve chemical tests, physical tests, or tests. In systems engineering it may involve black-box testing performed on a system (for example: a piece of software, lots of manufactured mechanical parts, or batches of chemical products) prior to its delivery formal testing with respect to user needs, requirements, and business processes conducted to determine whether a system satisfies the acceptance criteria and to enable the user, customers or other authorized entity to determine whether or not to accept the system. Acceptance testing is also known as user acceptance testing.

2.5 Separator 5: Design Output Stage:

- Final tool drawing
- Master copy stored in computer

i) Final tool drawing:

Final tool drawing is technical drawing is essential for communicating ideas in industry and engineering. To make the drawings easier to understand, people use familiar symbols, perspectives, units of measurement, notation systems, visual styles, and page layout. Together, such conventions constitute a visual language, and help to ensure that the drawing is unambiguous and relatively easy to understand. These drafting conventions are condensed into internationally accepted standards and specifications that transcend the barrier of language making technical drawings a universal means of communicating complex mechanical concepts.

This need for precise communication in the preparation of a functional document distinguishes technical drawing from the expressive drawing of the visual arts.

ii) Master copy stored in computer:

Many modern computer systems provide methods for protecting files against accidental and deliberate damage. Computers that allow for multiple users implement file permissions to control who may or may not modify, delete, or

create files and folders. For example, a given user may be granted only permission to read a file or folder, but not to modify or delete it; or a user may be given permission to read and modify files or folders, but not to execute them.

When computer files contain information that is extremely important, a back-up process is used to protect against disasters that might destroy the files. Backing up files simply means making copies of the files in a separate location so that they can be restored if something happens to the computer, or if they are deleted accidentally.There are many ways to back up files. Most computer systems provide utility programs to assist in the back-up process, which can become very time-consuming if there are many files to safeguard. Files are often copied to removable media such as writable CDs.

2.6 Separator 6: Design Validation:

- Tool data is specified on assembly drawing
- Quality control report

i) Tool data is specified on assembly drawing:

A complete assembly drawing is presentation of the product or structure put together, showing all parts in their operational positions. The separate parts come to the assembly department after their manufacturing processes are finished and in this department they are put together according the assembly drawings. Small machining operations may be necessary during assembly process such as drilling, reaming, or hand finishing. For such cases, assembly drawings include a note explaining the required operation and give the dimensions for the alignment or location of the pieces.

Several different methods can be used to produce assembly drawings; the simplest one tracing from the design layouts. This method is inferior to the method that the assembly drawing is produced from the dimensions of detail drawings if the accuracy of checking considered. Nowadays, there are so sophisticated programs and equipments, almost all the manufacturers use these programs to recover high initial costs. Although many assembly drawings do not need dimensions, the overall dimensions and distances between the centers or from part to part of the different pieces to clarify the relationship of the parts with each others. An assembly drawing should not be overloaded with detail.

ii) Quality control report :

Quality controls report include product inspection, where every product is examined visually, and often using a stereo microscope for fine detail before the product is sold into the external market. Inspectors will be provided with lists and descriptions of unacceptable product defects such as cracks or surface blemishes for example. The quality of the outputs is at risk if any of these three aspects is deficient in any way.

Quality control emphasizes testing of products to uncover defects and reporting to management who make the decision to allow or deny product release, whereas quality assurance attempts to improve and stabilize production (and associated processes) to avoid, or at least minimize, issues which led to the defect(s) in the first place. For contract work, particularly work awarded by government agencies, quality control issues are among the top reasons for not renewing a contract.

In the companies that are following their standards, quality manual or project quality plan etc. then most likely quality reports would be one of documents that would have been written and will be provided during the progress of the project.

2.7 Separator 7: Design Changes:

- Customer for product design modification
- Production for drawing modification
- Improvement by design department

i) Customer for product design modification:

Modification in design is important for development of product every manufacturer and every producer must conduct some sort of research and new product development, or his production standards will lag behind until finally run over by the competition. For today's industry, the design of new parts, products, or systems, and their development is an absolute must; it is a matter of survival. Various companies comply with these demands differently. Research and development are very much needed, they are almost equally unprofitable innovations, and the company's leadership should always be patient enough to lend them an ear and sincerely evaluate their proposals and ideas. Because anyone who stands still and does not progress is actually moving backward.

ii) Production for drawing modification:

Production drawings (sometimes called working drawings) are complete sets of drawings that detail the manufacturing and assembly of products (as distinct from engineering drawings prepared by and/or for production engineers whose task it to decide how best to manufacture the products).Machine operators, production line workers and supervisors all use production drawings.

Design engineers also use orthographic or pictorial views called "working cases" to record their ideas. These preliminary sketches are used as the basis for both the component and assembly drawings. Production drawings are 'drawn' (graphic) information prepared by the design team for use the construction or production team, the main purpose of which is to define the size, shape, location and production of the building or component'.

iii) Improvement by design department:

A continual improvement process, also often called a continuous improvement process (abbreviated as CIP or CI), is an ongoing effort to improve products, services, or processes. These efforts can seek "incremental" improvement over time or "breakthrough" improvement all at once. Delivery (customer valued) processes are constantly evaluated and improved in the light of their efficiency, effectiveness and flexibility.

A broader definition is that of the Institute of Quality Assurance who defined "continuous improvement as a gradual never-ending change which is: '... focused on increasing the effectiveness and/or efficiency of an organization to fulfill its policy and objectives. It is not limited to quality initiatives. Improvement in business strategy, business results, customer, employee and supplier relationships can be subject to continual improvement. Put simply, it means 'getting better all the time. Improvements are based on many small changes rather than the radical changes that might arise from Research and Development.

3. PRESS TOOL CALCULATION

3.1 Cutting Force (fsh):

Cutting force is a force which has to act on stock material in order to cut out the blank or slug .This determine the capacity of the press to be used for the particular tool.

Cutting force=L x S x Tmax

Where

L = Peripheral length of profile to be cut in mm

S =Sheet thickness in mm.

Tmax = Ultimate shear stress in N/mm²

Total cutting periphery = 603.5712mm

So, cutting force, fsh = 603.5712 x2.18 x350

= 460524.8256N

1.2 Shear Force(Fsh):1.25 x fsh

Thus, shear force in this case, Fsh = 1.25 x 460524.8256

= 575656.032N

3.3 Clearance Per Side(C/2) :

C/2=c x s x √Tmax/√10

Where: - c =Constant s =Sheet thickness in mm

Thus, clearance per side = 0.001x 2.18 x √350/√10

= 0.1289 mm.

3.4: Stripping Force (Fst) :

Fst = 0.2 x Fsh

Fsh = Shear force

So, stripping force in this case,

Fst = 0.2 x 575656.032N =115131.21N

3.5Total Force Required (Ft):

Ft = Fsh + Fst

Where:

Fsh = Shear force

Fst = Stripping force.

So,Totalforce,Ft
=575656.032+115131.21=690787.24N

=69.1 Tons ≈ 70 Tons

3.6 Total Machine Tonnage Required:

Considering 20% safety factor,

F = 1.2 x Ft

Ft = Total force

Total machine tonnage = 1.2 x 70 = 84 Tons.

4. CONCLUSION

In this we have studied design activity required for the press tool design. Design activity is classified in seven separators and studied the bill of material the tonnage required for press tool considering safety factor was 84 tons.

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Authors

Chetan B. Kawale

He is currently pursuing Bachelor of Engineering in Mechanical from DES's College of Engineering & Technology, Dhamangaon (Rly.), Maharashtra, India.

Ankush R. Daware

He is currently pursuing Bachelor of Engineering in Mechanical from DES's College of Engineering & Technology, Dhamangaon (Rly.), Maharashtra, India.

Anikit V. Thakare

He is currently pursuing Bachelor of Engineering in Mechanical from DES's College of Engineering & Technology, Dhamangaon (Rly.), Maharashtra, India.

Gokul B. Ajmire

He is currently pursuing Bachelor of Engineering in Mechanical from DES's College of Engineering & Technology, Dhamangaon (Rly.), Maharashtra, India.

Prof. C. G. Deshmukh

He has completed Master of Engineering degree in Mechanical (CAD/CAM).He received Bachelor of Engineering degree in Mechanical Engineering. He is currently working as assistant professor in Mechanical from DES's College of Engineering & Technology, Dhamangaon (Rly.), Maharashtra, India.