

## **ADVANTAGES OF COMPUTER AIDED DESIGN FOR MECHANICAL ENGINEERING DESIGN**

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**Abstract.** The paper presents some aspects and advantages of Computer Aided Design and CAD systems in mechanical engineering design. Mechanical engineering design plays a vital role in redefining lifestyle. Classical methods consume more time and resources in recreating, redesigning or retooling of models. Mechanical design engineer can easily design and prepare a product taking it to a finished stage has become rapid and saving time and money, by providing prototypes to designers and engineers.

### **1. Introduction**

In present of highly competitive business, it is very much necessary to come up with innovative ideas and designs of products for optimized performances to thrive in the fierce competition amongst the producers of the similar product line. The computer system has reduced the tasks and risks of a mechanical engineer hugely thereby minimizing the loss of time in any project. The most important phase of any mechanical engineering discipline is the design procedures.

The usability, reliability and durability of the product depend on the correctness of its design. The engineers or manufacturers need to know the applicability of the design without any financial or life loss but at the same time applying the real life constraints [1].

Mechanical engineering design plays a vital role in redefining lifestyle. Classical methods consume more time and resources in recreating, redesigning or retooling of models. In present, every growing technological world, mechanical engineering design field has attained a respectable position in the business market. Mechanical design engineers can easily design and prepare a product taking it to a finished stage has become rapid and saving time and money, by providing prototypes to designers and engineers. Mechanical engineering design produces accurate models with the use of fast modeling technology. During the product development, the engineer will receive the benefits in term of money, speed and accuracy. Mechanical engineering design assists in the prototype testing phase with the ability to produce multiple prototypes rapidly and more proficiently.

### **2. Advantages of Computer Aided Design**

Using Computer Aided Design or CAD software, there are number of advantages. Some of the advantages are tangible for they are visible in the design and production process, while the other advantages are intangible, which may not be visible directly but result in improvement in the quality of product and process. Some of the advantages of using CAD software are:

#### *2.1. Increase in productivity of the designer*

By using CAD software, the designers can do the designing work faster. This help the company to maintain competitive side where the trend is for low cost and high quality products. Some factors that decide the increase in productivity by using CAD software compared to using classical designing process are [2], [3]:

- *Complexity of engineering drawings.* For highly complex drawing, the classical drawing process consume lots of time.

- *The details required in the drawing.* If more details in the drawing are require, it can be done much faster with CAD software.
- *The number of repeated parts in the drawing.* There is a feature of saving the repeated drawings in CAD software and they can be used in any other drawing without having to draw them again. There is also library feature in CAD software, where a number of ready made the drawing of most frequently used components is available readily.
- *Annotation symbols and notes.* Save time and increase accuracy by using standards-based mechanical symbols and notes. Many of CAD software, such as AutoCAD Mechanical includes drafting tools to create standards based surface texture symbols, geometric dimensioning and tolerances, datum identifiers and targets, notes, taper and weld symbols.
- *Symmetry required in the drawing.* The symmetry feature in the CAD software, helps drawing symmetrical parts faster.

#### 2.2. *Easy to prototyping and manufacturing*

One of the importance advantage of using computer aided design and drafting is the ease of manufacturing. The integration of computer aided design and computer aided manufacturing system (CAD/CAM), great reduces time required for production planning. The advantages of CAD in manufacturing systems are [2], [3], [4]:

- *Designing tools and device for the manufacturing.* For manufacture of every component of parts, are require different tools and device.
- *Programming for manufacturing the job.* For manufacturing any job on computer numerical controlled machine programming is very essential. During programming process the time required for each machining process is also considered. The since all the data related to the materials, dimensions, finish required are mentioned in the final design of the product, and it can be directly used in the CAM systems for developing the program.
- *Shorter manufacturing lead time.* With CAD various lead the time required for manufacturing are reduced significantly.
- *Fast and accurate drawings.* Waiting for the assembly and parts drawing and objects is one of most common reasons for the lost of time between designing and manufacturing. This time can be reduced substantially, with fast designing and drawing process using CAD systems.
- *Short lead time.* Many processes become faster thus reducing the lead time, by using CAD systems. The CAD/CADD process is inherently faster than classical process. Achievement the drawings of assembly and part drawings, making specifications, preparing list of materials, are all much easier and faster by using the CAD systems. The processes in which lead time is reduced compared to classical designing and drafting processes.
- *Launching to the market the new product.* If the company has to launch new product the designing and drafting process, ca be completed faster which also translates in to faster manufacturing of the product.
- *Reduction in overall time of manufacturing.* The total time required for manufacturing the product includes the time required for designing, engineering, analysis, drafting and actual manufacturing of the product.
- *Design analysis.* Design analysis with CAD systems helps in achieving optimum design and reducing overall time for designing the product. Using Computer Aided Engineering (CAE) programs, mechanical design team can quickly and cheaply iterate the design process to develop a product that better meets cost, performance and other constraints. No physical prototype need be created until the design nears completion, allowing hundreds of designs to be evaluated, instead of a relative few.

- *CAD and CADD system helps reduce errors.* In the classical design and drafting process, there are some errors. The CAD systems can automatically carry out a number of repetitive tasks like placing multiple symbols, use drawings from the library and stored files drawing. The errors reduction help reduce the precious time that would have gone into finding the errors and nullifying them. It increases the overall productivity of the designer and the industrial company.
- *CAD systems, help in standardization of procedures.* The interactive CADD systems help in standardization design, drafting / drawing and documentation procedures. This removes all the confusions regarding the procedures to be followed for design, drawing and documentation and they will be similar for all objects.
- *CAD systems, helps in improvement in procedure for making engineering changes.* A lot of time some changes have to be made in the design of the product. This can be done easily in the CAD systems since all the drawings and reports are located within the CAD system of the computer. Easy editing is the biggest advantages of CAD systems. It is the ability to quickly and easily revise a design.
- *CAD systems allow an easier evaluation.* A design made on a CAD system is also easier to review and evaluate. Three dimensional models can be viewed from any angle and rotated on any axis. CAD systems also offer a zoom feature, allowing for a more up close view of individual detail than traditional methods might offer. Three dimensional cross-section of the design can also be made, revealing in detail the spatial relationship between elements of the design.
- *Cost estimation* is another advantage. CAD system can also have a built in system for calculating the cost of manufacturing the design, including any materials used, separate components, and additional items.

### *2.3. Key benefits of three-dimensional CAD design in mechanical engineering design.*

Using three-dimensional design modeling greatly improves design quality, because it is more complete process than 2D designing. In this case many human errors that can occur with classical 2D design methods are avoided. With 2D methods view are visually representative but quantity data from view is poor, because projections might while other component might be completely omitted to maintain drawing clarity. Using 3D design modeling to get quantity data is easy because items are represented as they occur. Consequently as long as a CAD 3D design is created as a true to life model, the 3D modeling design represents quantities with exact accuracy. Communication of design intent is vastly improved by using CAD 3D modeling. Consequently, it is possible to communicate a 3D modeling design and promote inter departmental understanding earlier in the project cycle, thus creating a time saving. Clearer communication of design intent at the earliest stage is always useful.

*Designing products with 3D CAD.* Designing products with three dimensional CAD data has many benefits compared to previous designs in 2D format. Advances in technology and interfacing the data with other process allow the following advantages:

- There are many different programs that can be use designing in 3D. Some of these programs such as Solid Works, AutoCAD Mechanical, Unigraphics NX, Pro-engineer and other, are formatted such that they can read and use each others data to create there own files.
- Significant cost savings can be achieved from evaluating a design in 3D. Once the design has been evaluated and proven, tooling can be machined from the data, which will give the correct sizes post manufacture.

- Design data can also be used to manufacture rapid prototypes. The rapid prototypes can then be used to evaluate the design, by checking clearances in assemblies, the functionality and full movements and the aesthetics of the design.

Recently, the process of rapid prototyping has become as important parts of three dimensional CAD and modeling. CAD modeling is usually the first step in a rapid prototyping system. Rapid prototyping technologies are a proven method the overall design process involved in developing a product or improving an existing one. Some of the advantages of inexpensive rapid prototyping are [6]:

- the parts can be formed with any geometric complexity and intricacy without the need for complicated machine-tool set-up;
- allows design engineers to test form, fit and function of a rapid prototype model;
- provides the option of developing as many design iterations as necessary, including those with functional parts due to advances in rapid prototyping application;
- reduces design time that in turn speed up a product's time to market;
- facilitates the identification of design flaws early in process that results in cost savings;
- the ABS rapid prototype models, can be made from durable ABS plastic which can be drilled, tapped, sanded or painted;
- Rapid prototyping can lead to more effective strategic planning and concurrent engineering by exchanging prototypes early in the stage of design manufacturing can start tooling up for production while the sales or marketing team starts planning the packaging all before the design is finalized.

### **3. Conclusions**

Computer Aided Design is an ideal means, that want to improve quality and reduce development cycles and costs. A design built with CAD systems should be of higher quality than one made by classical means. The geometric model in the computer is accurate and unambiguous. A 3D CAD model of a part can be displayed on display of PC or workstation so the designer can see what it really looks like. The model can be viewed from different angles and magnified so the designer sees the details on the screen. Any errors can be easier corrected immediately. Analysis can be carried out while the model is still in the computer, there is not need to wait for a physical prototype before testing starts. If a physical prototype is really necessary it can be produced directly from the CAD model by Rapid Prototyping technologies, again avoiding all the traditional costs of model making.

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