Study of Computer Aided Design and Mechanical Design by Computer Software

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Abstract – CAD is utilize of computer systems to help create, alter, analyze or optimize an engineering design. CAD technology is utilize to maximize designer's productivity, enhance design quality, improve documentation interaction & build production database. Sometimes, CAD performance is in printing, packaging or other processes of production. In compliance with application-specific standards, technological & engineering diagrams & photographs should convey information like materials, procedures, measurements & tolerances. CAD can be utilize in three-dimensional (3D) space to model curves, figures, lines, surfaces & solids. For special effects utilize in advertisements & technical manuals, for example, CAD is also & to create computer animation. CAD is significant industrial art & way of achieving projects. It is commonly utilize in various fields, including automotive, shipbuilding, aviation & industrial design. The process & performance of CAD is significant for effective engineering & manufacturing issues solutions. CAD software helps us to explore ideas, imagine concepts by means of photorealistic renditions, movies & simulate how design project will perform in real world.

Keywords: Computer Aided Design, Mechanical Design, Computer Software, 2D, 3D.

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I. INTRODUCTION

CAD is utilize of computer software to model & record design process of product. Engineering drawing includes utilize of symbols including points, lines, curves, planes & shapes. Essentially, in graphical form, it provides detailed description of any element. For more than 2000 years, engineering drawings have been in use. Nevertheless, in 18th century, formally introduced utilization of orthographic projections. Because model drawings have evolved beneath years & have become popular.

Although earlier concept sketches have been handmade, studies have presented that designs for engineering are quite complicated. A solution to several issues in engineering needs combination of structure, evaluation, concepts of problem solving & visual representation of problem. Shown via technical drawing (known as drafting) describing designs & specifications of physical object & the relationships between objects. Since & clearly communicates all the object data, it must be correct, CAD comes to fore here.

CAD wasn't exactly an economic proposition when it was first introduced because the computers were very expensive at that time. Mini-computer & subsequently microprocessor, the growing computer power in later part of 20th century has permitted that are an accurate representation of object's dimensions / properties. Computer-aided design (CAD) requires the development of geometrical parameter-defined computer models. Such models typically appear as 3D representation of component or group of parts on a computer monitor, which can be easily changed by modifying specific parameters.

CAD systems allow designers to display and evaluate models beneath huge range of representations. Computer-assisted development (CAM) uses data on geometric design to monitor automated machinery. Computer numeric control (CNC) and direct numerical control (DNC) systems are synonymous with CAM systems. Such systems differ from older forms of numerical control (NC) by mechanically encoding geometric information. Because both CAD & CAM utilize computer-based process to decode geometric data, highly integrated design and manufacturing processes can be accomplished. Computer-assisted development and production systems are normally referred to as CAD/CAM.

II. THE ORIGINS OF CAD/CAM

CAD emerged from 3 different sources, which also help to illustrate the basic operations supported by CAD systems. Attempts to automate drafting process resulted in 1st source of CAD. The Motors Research Labs led these advances in early 1960s. One of significant time-saving benefits of software modeling over traditional design methods is that by adjusting the parameters of a model, the latter can be rapidly corrected or manipulated. The second source for CAD was model software designs. High-tech industries such as aerospace and semiconductors pioneered utilize products.

The 3rd was the efforts made to promote flow from design process to manufacturing process utilizing numerical control (NC) technologies, that in the mid-1960s had widespread use in many applications. It was this the CAD-CAM link. One of significant developments in CAD / CAM technology is the ever closer integration of CAD / CAM-based production processes.

The development of CAD and CAM and especially the interaction between the two overcome conventional NC limitations in cost, ease of use and speed by allowing the design and manufacture of a component to be carried out using the same geometric data encoding method. This breakthrough significantly shortened the time between design and manufacture and widened the range of manufacturing processes for which automated machinery could be used economically. Just as significantly, CAD / CAM provided much more direct control over the production process to the architect, increasing the possibility of fully integrated design and manufacturing processes.

In the early 1970s, the rapid increase in use of CAD / CAM technology when machine costs continued to decline and their processing power grew, use of CAD / CAM spread from large firms to enterprises of all sizes utilizing large-scale mass production techniques related to CAD / CAM also grew. In addition to parts forming by conventional machine tool processes such as stamping, drilling, milling and grinding, CAD / CAM has been used by companies involved in the manufacture of consumer electronics and electronic components, molded plastics, and a host of other products.

Computers are utilized to control variety of production processes that are not strictly specified as CAM as control data are not based on geometric parameters. Using CAD, the motion of a component through a production process can be modeled in three dimensions. This process can simulate feed rates, machine tool angles and speeds, part holding clamp position, range & other constraints limiting a machine's operations. One of key means of increasing integration of CAD & CAM systems is the continuous development of simulation of different manufacturing processes.

III. USE OF CAD

CAD is utilized to carry out concept designs and plans, design details and measurements, build 3-D models, produce and publish diagrams, and interface with technical, advertising, manufacturing and end-user personnel. CAD facilitates the production process by transferring detailed product information in an automated form that can be interpreted universally by trained staff. It can be utilized to generate two or three-dimensional diagrams. Use CAD software tools allows visualization of the model from any perspective, even from the inside. One of benefits of CAD drawing is that editing is a quick process compared to manual process.

In addition to comprehensive engineering of 2D and 3D models, CAD is commonly used to describe component production from conceptual design to product layout. Through allowing detailed simulation rather than constructing and testing physical models, CAD reduces design time. CAD with CAM integration further streamlines product development. In industrial products, animated films and other uses, CAD is generally commonly used. The printing of professional design renderings typically requires a special printer or plotter. CAD programs either use graphics based on vectors or raster graphics that display how an object looks.

IV. CAD SOFTWARE ENABLES

- Design quality efficiency.
- Engineer productivity increase.
- Enhance record keeping through better documentation and communication.

Today, utilization of CAD has permeated nearly every industry. CAD is utilized in all vertical industries from aerospace, electronics to manufacturing. When CAD encourages innovation and accelerates efficiency, it becomes increasingly utilized as significant equipment for modeling before a manufacturing process is actually implemented. This is also one of reasons why CAD education is becoming increasingly important.

V. TYPES OF CAD SOFTWARE

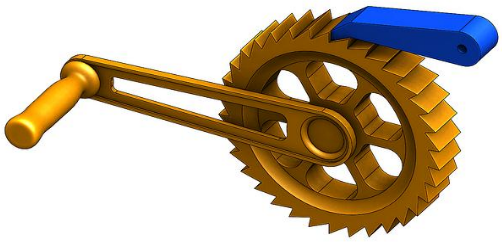
CAD software has been developing by leaps and bounds since its launch in the late 1960s. A broad CAD category is:

- 2D CAD
- 3D CAD
- 3D Wireframe and Surface Modeling
- Solid Modeling

With more and more (if not all) businesses switching to CAD / CAE / CAM to achieve product performance, reliability and reduced time-to-market, the demand for CAD software is growing. AutoCAD, Dassault Systems, and Altair are among the industry leaders in this area.

VI. MECHANICAL DESIGN USING CAD

CAD is utilized for computer software to make it easier to generate, modify and optimize a part or compile parts. The use of part design software permits for higher precision, easier & more accurate design iterations & comprehensive part & project management documentation (e.g. integration with a traditional Bill of Materials or BoM). A variety of vendors have applications for CAD. We are using Solidworks at Creative Mechanisms. Some of CAD's strengths over traditional design and/or 3-D modeling include:



- CAD makes automation and/or process modeling easy and accurate (known as Mechanical Design Automation). Traditionally, MDA was not possible without 1^{st} building and assembling physical prototype of each part of the system to check the functionality. Before ever creating a physical model, ability to digitally design & automate prototype adds tremendous flexibility to production processes and cost-reduction benefits.

- CAD allows computer-aided manufacturing (CAM) capability. For example, the incorporation of CAD technology with CNC machines or processes of additive manufacturing (3D printers) e.g. Modeling of fused deposition (FDM) devices.

- CAD takes into account the properties of materials and the interactivity of different materials.

- CAD permits maximum accurate dimensional analysis & numerical scalability using vector graphic technology (mathematical formula-based digital images).

- CAD has highly accurate component sensitivity (much smaller part error margin).

CAD for Static Mechanical Design and Mechanical Design Automation (MDA): One of the great advantages of CAD software is its ability to simulate 3D modeling and incorporate different parts of the same component in tandem.

CAD for Computer Aided Manufacturing (CNC & Additive Manufacturing): At Creative Mechanisms, we use a fully integrated software package that connects our CAD (Solidworks) technology with our heavy machinery (2 single-tool CNC machines, one 16-tool CNC machine and one industrial-grade FDM machine or "3D printer"). The advantage of having fully integrated system is that revisions of layout can be made almost instantly without the hassle of downloading and uploading it whenever you want to print a modified component. This is a small thing that makes a big difference to successful rapid prototyping.

CAD for Manufacturing (Injection Mold Automation): There are not many techniques competing with injection molding to mass manufacturing. One of significant things to consider when designing mold development for injection is the mold flow characteristics (the way molten plastic moves through the molding device before being solidified into the form of your part). We use plastics from Solid works to refine our production designs. Proper diagnosis and development experience with right software equipment’s can help minimize faults and optimize the return on investment.

VII. MOST IMPORTANT SOFTWARE FOR MECHANICAL ENGINEERS

Mechanical engineers use a lot of software packages, but there are a few that are consistently used across the industry. The level of skill required for specific software packages depends on your engineering position. Nonetheless, with most of the technology on this list, each mechanical engineer should have at least basic familiarity.

Mathcad

Mathcad may be one piece of software that is useful to any mechanical engineer, regardless of their job function. Mathcad provides ability to do math as well as add related images & text to illustrate your work within a file. You can add plots that either read from data arrays or connect to specified equations. The outcome is a beautifully structured file with estimates of your "hand."

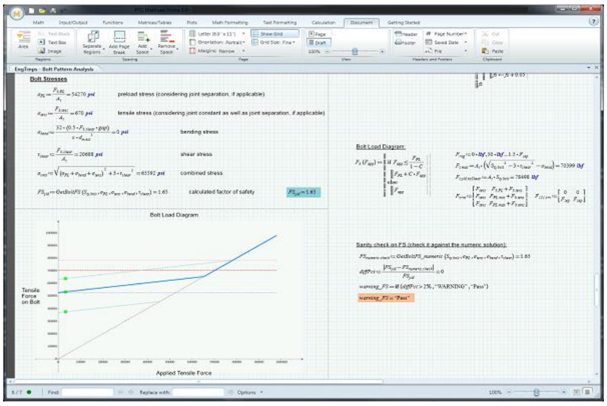
- Ability to write and test formulas

- Unit conversion

- Plotting

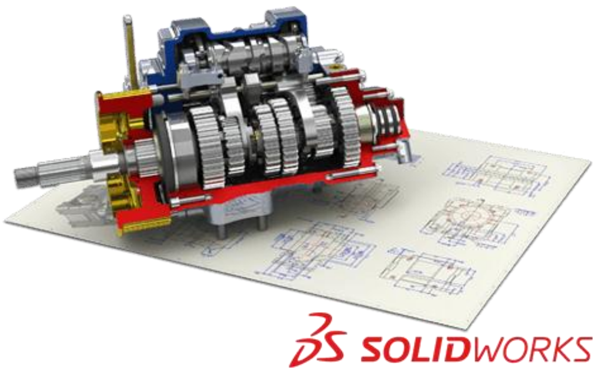
- Linear algebra useful to solve 3D static problems, to solve linear equation systems, etc.

- Symbolic equation solver useful when you just don't feel like solving t manually solving for integral of some complex equation



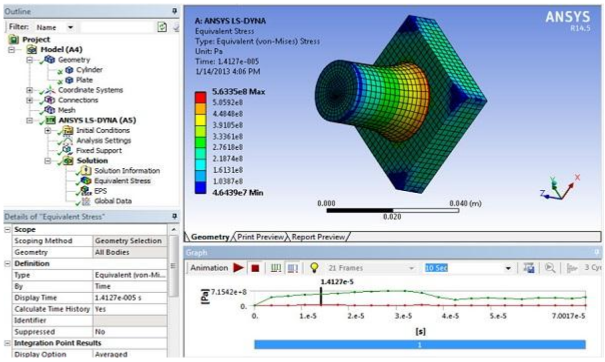
CAD Software

For any engineer with an emphasis on technology, 3D CAD kit is particularly useful. This software permits to create parts and assemble 3D models. For example, you can design and incorporate all the individual parts of an engine into an assembly. This will permit the parts fit as expected. Most CAD packages allow you to do things such as allowing parts to be moved (i.e. allowing a shaft to rotate) or testing for parts interference. Many CAD packages have a drafting feature that permits to create your parts ' 2D drawings so they can be made. Many CAD equipment have direct integration into FEA (Finite Element Analysis) package, allowing you to iterate among design & analysis seamlessly.



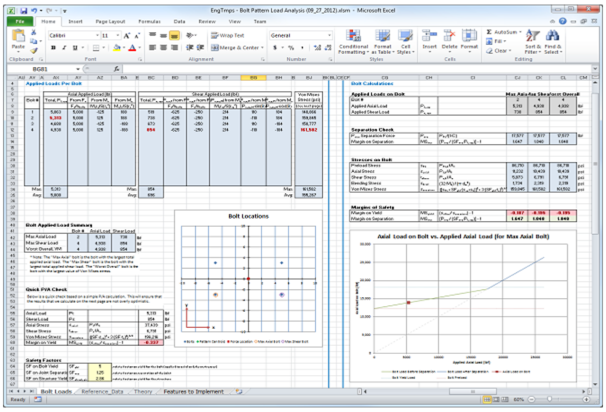
FEA Software

FEA is useful for any engineer requiring structural analysis. You can analyze stresses & deflections in complex structures using this tool. ANSYS and Nastran are popular examples. In 3D CAD system, usually a design is modeled and then passed to the FEA code. Originally, CAD template to a file format that the FEA program could then interpret, but now many FEA packages integrate directly with CAD packages to make the transition seamless. A mesh is generated once the geometry is designed to separate the structure into components. Forces & constraints are applied, & model can then be solved. From solved model you can interrogate stresses & deflections in structure.



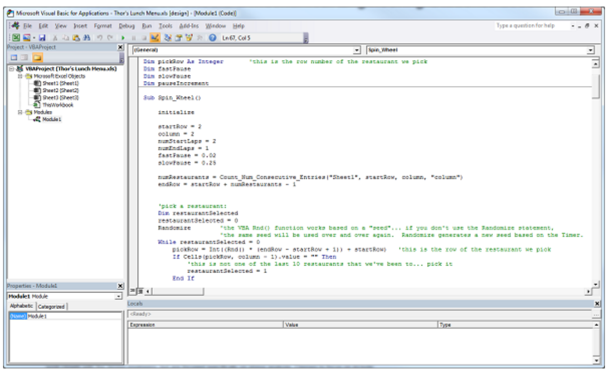
Microsoft Excel

Excel is perhaps the most flexible application used by almost every office worker, not only by mechanical engineers. Excel is useful for simple calculations, data tabulation, ideas design, shape drawing, basic programming there are endless possibilities.



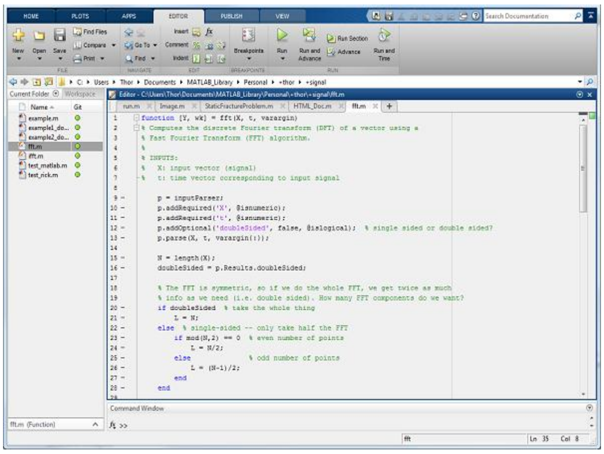
Visual Basic for Applications (VBA)

It is useful to automate Excel files, access files, Word files, and any other files that are generated using the MS Office suite. Compared to other more complex programming languages, it can be a bit clunky and difficult to use, but its easy incorporation into MS Office makes it an incredibly compelling choice for small scripts to perform basic automation tasks.



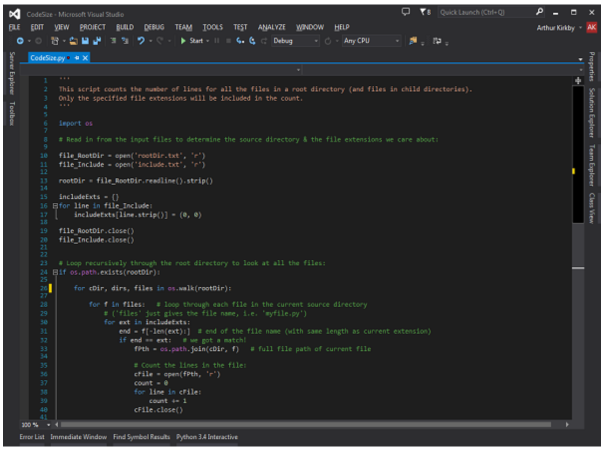
MATLAB

MATLAB is among mechanical engineers the programming language / environment of choice. For more complex numerical analysis, MATLAB is necessary is needed. MATLAB is particularly suitable for matrix and vector calculations. It has an outstanding plotting capability, so a simulation can be performed easily and results can be shown quickly. For more complicated things like development. Analyze the reaction characteristics of a spring-mass-damper with external force.



Python

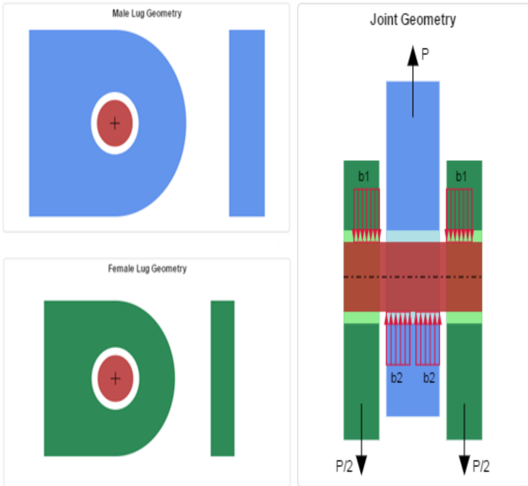
Python is a programming language of general use with a strong scientific programming capability. Python is therefore an excellent alternative to MATLAB. Python is an open source, and the popular Python community actively creates and manages many useful libraries. It is possible to achieve by downloading the libraries NumPy, SciPy and Matplotlib. Many other research collections, such as Pandas, are also available that are worth looking into as well. A benefit of Python (apart from the free price) is that it is a programming language of general purpose it means that in addition to numerical analysis, like working with file, maintaining a server, or creating a website.

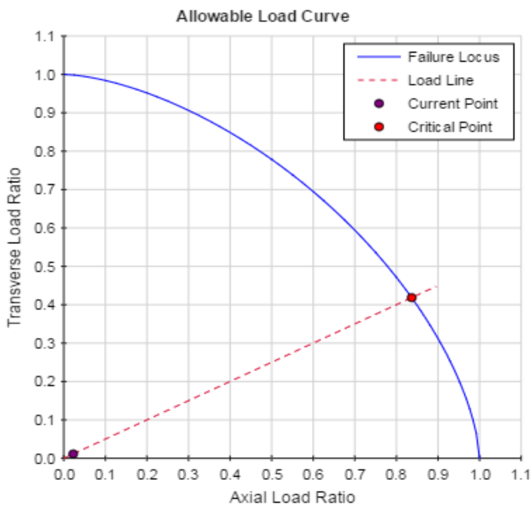


MechaniCalc (MC)

MC is suite of machine design & structural analysis-focused web-based calculators. Such calculators conduct analyzes that industry would anticipate while being intuitive and usable as well. Use these calculators more efficiently across development and evaluation cycles.

For many specific testing tasks, MechaniCalc provides calculators, including bolted joint analysis, lug analysis, buckling of columns, and more. It has a list of properties of materials and cross section properties that can utilized to calculators. This helps you to save your job and, for easy reporting, to print documents. All calculators can be tried free of charge, so check out our full calculator list here and get started.





CONCLUSION

CAD is a computer-assisted model. CAD is used for product design, production and optimization. While it is very flexible, CAD is commonly used both in manufacturing methods & in the construction domain in the design of tools and equipment needed. CAD helps design engineers to format and create, print and save their work for future editing on a computer screen. Mechanical engineering has undergone significant changes over the past decade, with a shift in focus in terms of scale, length, and applications. The design of nano and micromechanics. However, new design performance standards have become increasingly important, pressing for related developments in terms of new technologies and advanced approaches. An update of existing design tools is a matter of urgency in order to face these new challenges. This section developments in CAD on different aspects of mechanical engineering articles. Mechanical & mechanical properties of materials used in mechanics, philosophy, design, material & mechanical instrumentation, control theory and control engineering, mechanical problems like vibration and performance, etc. will be included in the topics. This section will merge together emerging CAD & mechanical design by computer software with traditional solid topics related to mechanical engineering. We hope that section will provide broad scope to researchers & engineers in this new interdisciplinary field.

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