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Design Modeling, Simulation of Spur Gear; Analysis of Spur Gears

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Abstract:- The range of computer applications in engineering design covers procedures from preliminary conceptual design to the production of manufacturing drawings and specifications. Most computer applications intended for production use can be classified into five or more major categories: analysis, computer-aided drafting and design, geometric modeling, data base management systems, and artificial intelligence. Gears are machine elements that transmit angular motion and power by the successive engagement of teeth on their periphery. They constitute an economical method for such transmission, particularly if power levels or accuracy requirements are high. Spur gears are the most common variety and the most economical to manufacture.. Axes of mating gears are parallel. Spur gears are used to transmit rotary motion between parallel shafts. They are cylindrical, and the teeth are straight and parallel to the axis of rotation. The pinion is the smaller of two mating gears; the larger is called the gear or the wheel. The scope of this work includes, to design, model and simulate Spur Gear, to select Gear materials ,to analysis spur gears also to detailed factor safety in design Computer aided design uses the mathematical and graphic processing power of the computer to assist the engineer in the creatoion, modification, analysis, and designs many factors have contributed to CAD technology becoming the necessary tool in the engineering technical data base, CAD combines the characteristic of designer and computer that are best applicable to the design process, the combination of human creativity with computer technology provides the design efficiency that has made CAD such as popular design tool. Gears are useful when the following kinds of power or motion transmission are required: (1) a change in speed of rotation, (2) a multiplication or division of torque or magnitude of rotation, (3) a change in direction of rotation, (4) conversion from rotational to linear motion or vice versa (rack gears), (5) a change in the angular orientation of the rotational motion (bevel gears), and (6) an offset or change in location of the rotating motion.

I. INTRODUCTION

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear.Two or more gears working in a sequence (train) are called a gear train or, in many cases, a transmission; such gear arrangements can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine Shown In Fig 11-12. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack, thereby producing translation instead of rotation. Early examples of gears date from the 4th century BCE in China (Zhan Guo times - Late East Zhou dynasty), which have been preserved at the Luoyang Museum of Henan Province, China. The earliest gears in Europe were circa CE 50 by Hero of Alexandria, but they can be traced back to the Greek mechanics of the Alexandrian school in the 3rd century BCE and were greatly developed by the Greek polymath Archimedes (287–212 BCE). Examples of further development include: Ma Jun (c. 200–265 CE) used gears as part of a south-pointing chariot.

The Antikythera mechanism is an example of a very early and mili, and other application of water mill often used gears intricate geared device, designed to calculate astronomical positions. Its time of construction is now estimated between 150 and 100 BCE. The water-powered grain-mill, the water-powered saw mill, fulling . The first mechanical clocks were built in CE 725. The 1386 Salisbury cathedral clock may be the world's oldest working mechanical clock.

CAD has its roots in interactive computer graphics. Before the CAD era, engineering drawings were prepared manually on paper using pencils and drafting instruments on a drafting table. The advent of interactive computer graphics replaced the drafting table with a computer monitor and the pencil with an input device such as a light pen or mouse. Instead of using physical drafting instruments, software commands and icons on the computer display are used. The drawing can be created, modified, copied, and transformed using the software tools. At the time, CAD stood for computer-aided drafting. Drafting was confined to 2D because of the paper limitation. With the computer, such limitation is removed. Three-dimensional CAD systems were developed in the 1960s. In 3D CAD, objects are modeled using 3D coordinates (*x*, *y*, and *z*) instead of 2D coordinates (*x* and *y*). The need for modeling parts and products with complex surfaces motivated the development of free-form surface modelers.

II. GEAR MATERIALS

Numerous nonferrous alloys, cast irons, powder-metallurgy and plastics are used in the manufacture of gears. However, steels are most commonly used because of their high strength-to-weight ratio and low cost. Plastic is commonly used where cost or weight is a concern. A properly designed plastic gear can replace steel in many cases because it has many desirable properties, including dirt tolerance, low speed meshing, the ability to "skip" quite well and the ability to be made with materials that don't need additional lubrication. Manufacturers have used plastic gears to reduce costs in consumer items including copy machines, optical storage devices, cheap dynamos, consumer audio equipment, servo motors, and printers. Another advantage of the use of plastics, formerly (such as in the 1980s), was the reduction of repair costs for certain expensive machines. In cases of severe jamming (as of the paper in a printer), the plastic gear teeth would be torn free of their substrate, allowing the drive mechanism to then spin freely (instead of damaging itself by straining against the jam). This use of "sacrificial" gear teeth avoided destroying the much more expensive motor and related parts. This method has been superseded, in more recent designs, by the use of clutches and torque- or current-limited motors.

III. SUITABLE MATERIALS FOR GEARS

Sufficient strength to transmit the power involved is a first requisite for any gear material. Machinability is also important for machined gears, for two reasons: A considerable amount of metal removal is involved when gears are machined, and it is easier to achieve precision of machining and smooth surface finishes (which are important in gears) when the metal used has favorable machinability ratings. Other properties that are almost always desirable and may be necessary for certain applications are corrosion resistance, dimensional stability, impact strength, light weight, high temperature resistance, heat treatability, wear resistance, natural lubricity or compatibility with lubricants, noise-damping properties (or limited noise-generating properties), and (lest we forget) low cost.

DESIGN RECOMMENDATIONS

The closely dimensioned and standardized configuration inherent in the function of gears severely limits the latitude of the designer in selecting a low-cost alternative design. Nevertheless, there are choices that the designer can make that will have a bearing on the cost and performance of gear components. Some points for consideration, applicable to machined, molded, cast, formed, or stamped gears, are the following:

1. Normally, the coarsest-pitch gear system that performs the required function will be the most economical to produce. The designer, if given a choice between finepitch gearing and coarse-pitch gearing and provided operating requirements permit, should choose the coarser-pitch system.

2. Helical, spiral, and hypoid systems are more difficult and costly to manufacture than straight-tooth designs. Straight-tooth systems should be specified unless noise or other considerations necessitate a helical configuration.

3. Dimensional tolerances, as controlled by AGMA or DIN gear numbers and permissible tooth-to-tooth and total cumulative variations and surface finishes, should be as liberal as the function of the gears permits. Gears, like other manufactured components, are subject to geometrically increased costs as tolerances are reduced

APPLYING COMPUTERS TO DESIGN

No other idea or device has impacted engineering as computers have. All engineering disciplines routinely use computer for calculation, analysis, design and simulation .Many of the individual tasks within the overall design process can be performed using a computer. As each of these tasks is made more efficient, the efficiency of the overall process increases as well. The computer is especially well suited to design in four areas, which correspond to the latter four stages of the general design process. Computers function in the design process through geometric modeling capabilities, engineering analysis calculations, automated testing procedures, and automated drafting.

STATIC ANALYSIS determines reaction forces at the joint positions of resting when a constant load is applied. As long as zero velocity is assumed, static analysis can be performed on mechanisms at different points of their range of motion. Static analysis allows the designer to determine the reaction forces on whole mechanical systems as well as interconnection forces transmitted to their individual joints.

The data extracted from static analysis can be useful in determining compatibility with the various criteria set out in the problem definition. These criteria may include reliability, fatigue, and performance considerations to be analyzed through stress analysis methods fig 3. Detailed the Region with FOS (factor of safety) value less than 1 in red

EXPERIMENTAL ANALYSIS involves fabricating a prototype and subjecting it to various experimental methods. Although this usually takes place in the later stages of design, CAD systems enable the designer to make more effective use of experimental data, especially where analytical methods are thought to be unreliable for the given model. CAD also provides a useful platform for incorporating experimental results

Modelling and simulation of spur gear

Fig: 1 spur gear

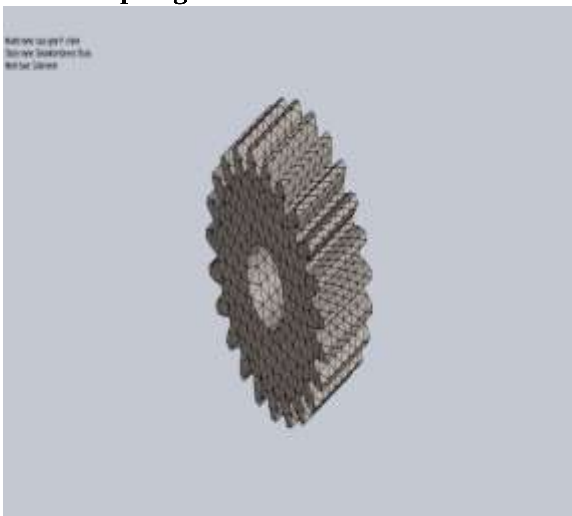

Fig: 2 Solid Mesh

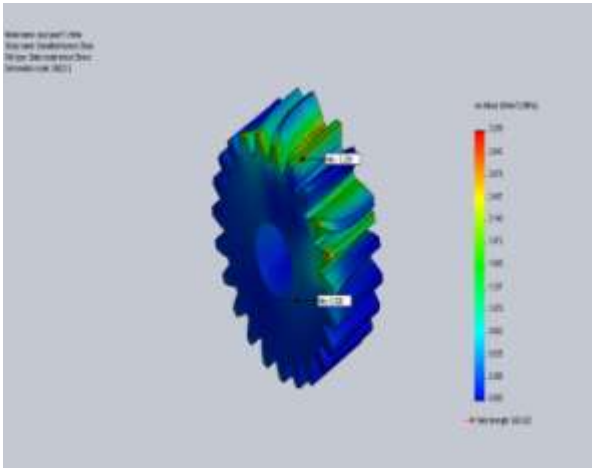

Fig: 3 Spur Gear under Stress

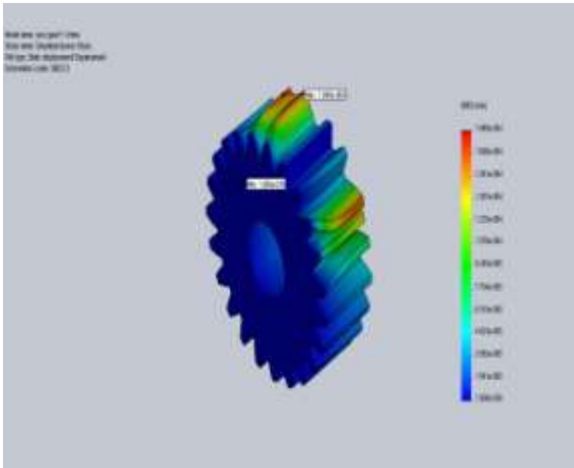

Fig: 4 Displacement

Fig: 5 Deformed Shape

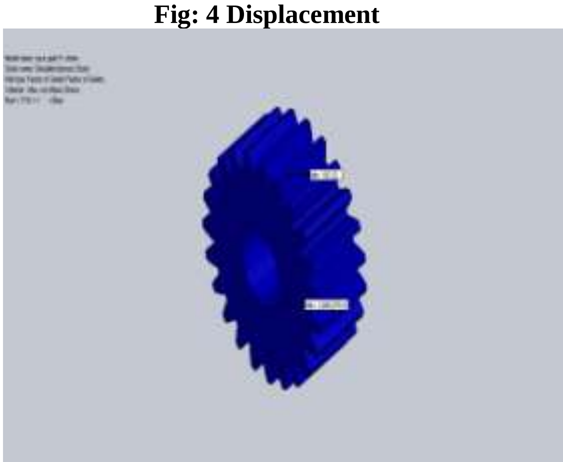

Fig: 6 Factor of Safety

Fig: 7 Spur Gears with Blind Hole

Fig: 8 Final Design of Spur Gears

Fig: 9 View of Wheel

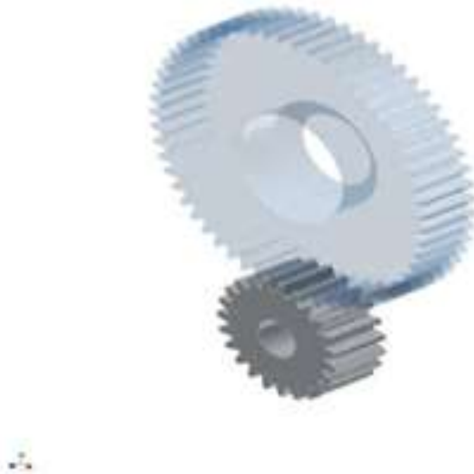

Fig: 10 View of Pinion

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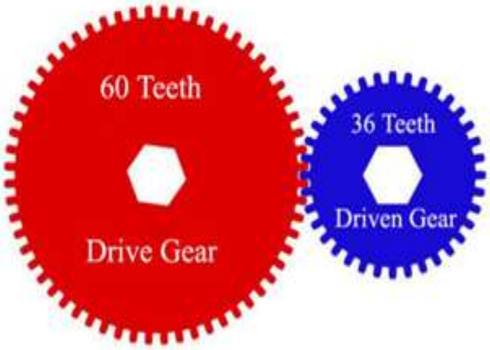


Fig 11.Spur Gears Arrangement

Fig: 12 Spur Gears Rotation

ANALYSIS OF SPUR GEARS ACCORDING TO ISO

Spur Gears Component Generator (Version: 12.0 (Build 120254000, 254))

12/26/2015

⊞ Project Info

⊟ Guide

Design Guide - Center Distance

Unit Corrections Guide - According to Merrit

Type of Load Calculation - Torque calculation for the specified power and speed

Type of Strength Calculation - Check Calculation

Method of Strength Calculation - According to ISO

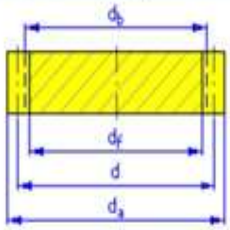
⊟ Common Parameters

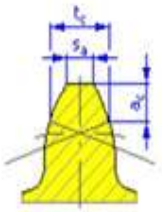
Gear Ratio	i	2.4783 ul
Desired Gear Ratio	i_{in}	2.4783 ul
Diametral Pitch	P	10.0000 ul/in
Helix Angle	β	0.0000 deg
Pressure Angle	α	20.0000 deg
Center Distance	a_w	4.000 in
Product Center Distance	a	4.000 in
Total Unit Correction	Σx	0.0000 ul
Circular Pitch	p	0.314 in
Base Circular Pitch	p_{tb}	0.295 in
Operating Pressure Angle	α_w	20.0000 deg
Contact Ratio	ε	1.6626 ul
Limit Deviation of Axis Parallelity	f_x	0.00047 in
Limit Deviation of Axis Parallelity	f_y	0.00024 in

⊟ Gears

		Gear 1	Gear 2
Type of model		Component	Component
Number of Teeth	N	23 ul	57 ul
Unit Correction	x	0.1400 ul	-0.1400 ul
Pitch Diameter	d	2.300 in	5.700 in
Outside Diameter	d_a	2.528 in	5.872 in
Root Diameter	d_f	2.078 in	5.422 in
Base Circle Diameter	d_b	2.161 in	5.356 in
Work Pitch Diameter	d_w	2.300 in	5.700 in
Facewidth	b	1.000 in	1.000 in
Facewidth Ratio	b_r	0.4348 ul	0.1754 ul
Addendum	a^*	1.0000 ul	1.0000 ul

Clearance	c^*	0.2500 ul	0.2500 ul
Root Fillet	r_f^*	0.3500 ul	0.3500 ul
Tooth Thickness	s	0.167 in	0.147 in
Tangential Tooth Thickness	s_t	0.167 in	0.147 in
Chordal Thickness	t_c	0.148 in	0.130 in
Chordal Addendum	a_c	0.087 in	0.062 in
Chordal Dimension	W	0.780 in	1.989 in
Chordal Dimension Teeth	z_w	3.000 ul	7.000 ul
Dimension Over (Between) Wires	M	2.605 in	5.969 in
Wire Diameter	d_M	0.188 in	0.188 in
Limit Deviation of Helix Angle	F_R	0.00047 in	0.00051 in
Limit Circumferential Run-out	F_r	0.00083 in	0.00110 in
Limit Deviation of Axial Pitch	f_{pt}	0.00033 in	0.00035 in
Limit Deviation of Basic Pitch	f_{pb}	0.00031 in	0.00033 in
Virtual Number of Teeth	N_v	23.000 ul	57.000 ul
Virtual Pitch Diameter	d_n	2.300 in	5.700 in
Virtual Outside Diameter	d_{an}	2.528 in	5.872 in
Virtual Base Circle Diameter	d_{bn}	2.161 in	5.356 in
Unit Correction without Tapering	x_z	0.3637 ul	-0.6749 ul
Unit Correction without Undercut	x_p	-0.3255 ul	-2.3142 ul
Unit Correction Allowed Undercut	x_d	-0.4955 ul	-2.4841 ul
Addendum Truncation	k	0.0000 ul	0.0000 ul
Unit Outside Tooth Thickness	s_a	0.6637 ul	0.8015 ul
Tip Pressure Angle	α_a	31.2467 deg	24.1934 deg





⊟ Loads

		Gear 1	Gear 2
Power	P	1.000 hp	0.980 hp
Speed	n	1000.00 rpm	403.51 rpm
Torque	T	5.252 lbforce ft	12.756 lbforce ft
Efficiency	η	0.980 ul	
Radial Force	F_r	19.947 lbforce	
Tangential Force	F_t	54.805 lbforce	
Axial Force	F_a	0.000 lbforce	
Normal Force	F_n	58.322 lbforce	

Circumferential Speed	v	10.036 fps	
Resonance Speed	n_{E1}	18754.249 rpm	

⊟ Material

		Gear 1	Gear 2
		nodular cast iron	nodular cast iron
Ultimate Tensile Strength	S_u	116000 psi	116000 psi
Yield Strength	S_y	69600 psi	69600 psi
Modulus of Elasticity	E	24500000 psi	24500000 psi
Poisson's Ratio	Ū	0.200 ul	0.200 ul
Endurance Limit	S_n	84120.0 psi	84120.0 psi
Surface Fatigue Strength	S_{fe}	69600.0 psi	69600.0 psi
Bending Fatigue Limit	σ_{Flim}	50000.0 psi	50000.0 psi
Contact Fatigue Limit	σ_{Hlim}	79800.0 psi	79800.0 psi
Hardness in Tooth Core	JHV	210 ul	210 ul
Hardness in Tooth Side	VHV	600 ul	600 ul
Base Number of Load Cycles in Bending	N_{Flim}	3000000 ul	3000000 ul
Base Number of Load Cycles in Contact	N_{Hlim}	50000000 ul	50000000 ul
Wöhler Curve Exponent for Bending	q_F	6.0 ul	6.0 ul
Wöhler Curve Exponent for Contact	q_H	10.0 ul	10.0 ul
Type of Treatment	type	0 ul	0 ul
Allowable Bending Stress	σ_{Ab}	21030.0 psi	21030.0 psi
Allowable Contact Stress	σ_{Ac}	2320.0 psi	2320.0 psi

⊟ Strength Calculation

⊟ Factors of Additional Load

Application Factor	K_A	1.200 ul	
Dynamic Factor	K_{Hv}	1.110 ul	1.110 ul
Face Load Factor	$K_{H\beta}$	1.790 ul	1.576 ul
Transverse Load Factor	$K_{H\alpha}$	1.283 ul	1.426 ul
One-time Overloading Factor	K_{AS}	1.000 ul	

⊟ Factors for Contact

Elasticity Factor	Z_E	167.289 ul	
Zone Factor	Z_H	2.495 ul	
Contact Ratio Factor	Z_ε	0.883 ul	
Single Pair Tooth Contact Factor	Z_B	1.027 ul	1.000 ul
Life Factor	Z_N	1.000 ul	1.000 ul
Lubricant Factor	Z_L	0.937 ul	
Roughness Factor	Z_R	1.000 ul	

Spur Gears Component Generator file:///C:/Users/ROMCHI~1/AppData/Local/Temp/DA/GEAR1/GEAR1.htm

Speed Factor	Z_v	0.939 ul	
Helix Angle Factor	Z_R	1.000 ul	
Size Factor	Z_X	1.000 ul	1.000 ul
Work Hardening Factor	Z_W	1.000 ul	

⊟ **Factors for Bending**

Form Factor	Y_{FA}	2.520 ul	2.389 ul
Stress Correction Factor	Y_{Sa}	1.625 ul	1.569 ul
Teeth with Grinding Notches Factor	Y_{Sag}	1.000 ul	1.000 ul
Helix Angle Factor	Y_R	1.000 ul	
Contact Ratio Factor	Y_ε	0.701 ul	
Alternating Load Factor	Y_A	1.000 ul	1.000 ul
Production Technology Factor	Y_T	1.000 ul	1.000 ul
Life Factor	Y_N	1.000 ul	1.000 ul
Notch Sensitivity Factor	Y_δ	1.460 ul	1.446 ul
Size Factor	Y_X	1.000 ul	1.000 ul
Tooth Root Surface Factor	Y_R	1.000 ul	

⊟ **Results**

Factor of Safety from Pitting	S_H	1.523 ul	1.565 ul
Factor of Safety from Tooth Breakage	S_F	15.496 ul	16.770 ul
Static Safety in Contact	S_{Hst}	4.224 ul	4.340 ul
Static Safety in Bending	S_{Fst}	26.531 ul	28.984 ul
Check Calculation		Positive	

⊟ **Summary of Messages**

12:05:20 AM Design: Gear 1: The Unit Correction (x) is less than the Unit Correction without Tapering (x_z)
12:05:20 AM Calculation: Calculation indicates design compliance!

4 of 4 12/26/2015 12:06 AM

IV. DESIGN PROCESS

The ability to create something out of nothing makes design one of the most exciting aspects of engineering. To be successful, design engineer require abroad set of talents include knowledge creativity, people skill and planning ability .Engineers use CAD to create two− and three−dimensional drawings, such as those for automobile and airplane parts, floor plans, and maps and machine assembly. While it may be faster for an engineer to create an initial drawing by hand, it is much more efficient to change and adjust drawings by computer. In the design stage, drafting and computer graphics techniques are combined to produce models of different machines. Using a computer to perform the six−step'art−to−part' process: The first two steps in this process are the use of sketching software to capture the initial design ideas and to produce accurate engineering drawings. The third step is rendering an accurate image of what the part will look like. Next, engineers use analysis software to ensure that the part is strong enough shown in fig;1; .Step five is the production of a prototype, or model CAD began as an electronic drafting board, a replacement of the traditional paper and pencil drafting method. Over the years it has evolved into a sophisticated surface and solid modeling tool. Not only can products be represented precisely as solid models, factory shop floors can also be modeled and simulated in 3D. It is an indispensable tool to modern engineers

WIRE FRAME The most basic functions of CAD are the 2D drafting functions. 2D geometry such as line, circles, and curves can be defined. A 2D profile can also be extruded into a 21⁄2 D object. The extruded object is a wireframe of the object CAD also allows a 3D wire-frame to be defined.To cover the wire-frame model, faces can be added to the model. This creates a shell of the object. Hidden line/surface algorithms can be applied to create realistic pictures. Many menu functions are used to help simplify the design process. Annotation and dimensioning are also supported. Text and dimension symbols can be placed anywhere on the drawing, at any angle, and at any size.

V. MODELLING

Modeling is the process of producing a model; a model is a representation of the construction and working of some system of interest as shown in fig 7-10. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modeling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output.

Generally, a model intended for a simulation study is a mathematical model developed with the help of simulation software. Mathematical model classifications include deterministic (input and output variables are fixed values) or stochastic (at least one of the input or output variables is probabilistic); static (time is not taken into account) or dynamic (time-varying interactions among variables are taken into account). Typically, simulation models are stochastic and dynamic

VI. SIMULATION

A simulation of a system is the operation of a model of the system. The model can be reconfigured and experimented with; usually, this is impossible, too expensive or impractical to do in the system it represents. The operation of the model can be studied, and hence, properties concerning the behavior of the actual system or its subsystem can be inferred. In its broadest sense, simulation is a tool to evaluate the performance of a system, existing or proposed, under different configurations of interest and over long periods of real time. Simulation is used before an existing system is altered or a new system built, to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance. For instance, simulation can be used to answer questions like:What is the best design for a new network? What are the associated resource requirements? How will a telecommunication network perform when the traffic load increases by 50%? How will new routing algorithm affect its performance? Which network protocol optimizes network performance? What will be the impact of a link failure? The subject of this tutorial is discrete event simulation in which the central assumption is that the system changes instantaneously in response to certain discrete events. For instance, in an M/M/1 queue - a single server queuing process in which time between arrivals and service time are exponential - an arrival causes the system to change instantaneously. On the other hand, continuous simulators, like flight simulators and weather simulators, attempt to quantify the changes in a system continuously over time in response to controls. Discrete event simulation is less detailed (coarser in its smallest time unit) than continuous simulation but it is much simpler to implement, and hence, is used in a wide variety of situations.

Figure, 2-6 is a schematic of a simulation study. The iterative nature of the process is indicated by the system under study becoming the altered system which then becomes the system under study and the cycle repeats. In a simulation study, human decision making is required at all stages, namely, model development, experiment design, output analysis, conclusion formulation, and making decisions to alter the system under study. The only stage where human intervention is not required is the running of the simulations, which most simulation software packages perform efficiently. The important point is that powerful simulation software is merely a hygiene factor - its absence can hurt a simulation study but its presence will not ensure success. Experienced problem formulators and simulation modelers and analysts are indispensable for a successful simulation study.

The steps involved in developing a simulation model, designing a simulation experiment, and performing simulation analysis are:

1. Step 1. Identify the problem.
2. Step 2. Formulate the problem.
3. Step 3. Collect and process real system data.
4. Step 4. Formulate and develop a model.
5. Step 5. Validate the model.
6. Step 6. Document model for future use.
7. Step 7. Select appropriate experimental design. Step 8. Establish experimental conditions for.
8. Step 9. Perform simulation runs.

9. Step 10. Interpret and present results.
10. Step 11. Recommend further course of action. Although this is a logical ordering of steps in a simulation study, much iteration at various sub-stages may be required before the objectives of a simulation study are achieved. Not all the steps may be possible and/or required. On the other hand, additional steps may have to be performed. The next three sections describe these steps in detail.

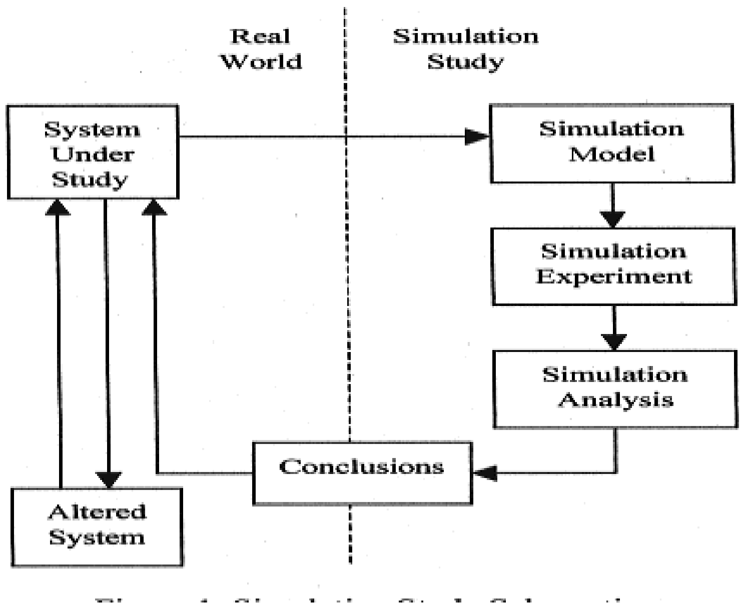


Fig 14: Simulation Study Schematic

VII. RESULT AND DISCUSS

Engineering analysis can be performed using one of two approaches: analytical or experimental. Using the analytical method, the design is subjected to simulated conditions, using any number of analytical formulae. By contrast, the experimental approach to analysis requires that a prototype be constructed and subsequently subjected to various experiments to yield data that might not be available through purely analytical methods. There are various analytical methods available to the designer using a CAD system. Finite element analysis and static and dynamic analysis are all commonly performed analytical methods available in CAD.

SAFETY An engineer must always design products that are safe for the end user and the artisans who construct the product.it is impossible to design completely safe products because they would be too costly. Therefore, the engineer often must design to industry standards for similar product

FACTOR OF SAFETY is the ratio of ultimate strength of the material to allowable stress. The term was originated for determining allowable stress. The ultimate strength of a given material divided by an arbitrary factor of safety, dependent on material and the use to which it is to be put, gives the allowable stress. In present design practice, it is customary to use allowable stress as specified by recognized authorities or building codes rather than an arbitrary factor of safety. One reason for this is that the factor of safety is misleading, in that it implies a greater degree of safety than actually exists. For example, a factor of safety of 4 does not mean that a member can carry a load four times as great as that for which it was designed. It also should be clearly understood that, though each part of a machine is designed with the same factor of safety, the machine as a whole does not have that factor of safety. When one part is stressed beyond the proportional limit, or particularly the yield point, the load or stress distribution may be completely changed throughout the entire machine or structure, and its ability to function thus may be changed, even though no part has ruptured. Although no definite rules can be given, if a factor of safety is to be used, the following circumstances should be taken into account in its selection:
1. When the ultimate strength of the material is known within narrow limits, as for structural steel for which tests of samples have been made, when the load is entirely a steady one of a known amount and there is no reason to fear the deterioration of the metal by corrosion,
the lowest factor that should be adopted is 3.
2. When the circumstances of (1) are modified by a portion of the load being variable, as in floors of warehouses, the factor should not be less than 4.
3. When the whole load, or nearly the whole, is likely to be alternately put on and taken off, as in suspension rods of floors of bridges, the factor should be 5 or 6.

4. When the stresses are reversed in direction from tension to compression, as in some bridge diagonals and parts of machines, the factor should be not less than 6.
5. When the piece is subjected to repeated shocks, the factor should be not less than 10.
6. When the piece is subjected to deterioration from corrosion, the section should be sufficiently increased to allow for a definite amount of corrosion before the piece is so far weakened by it as to require removal.
7. When the strength of the material or the amount of the load or both are uncertain, the factor should be increased by an allowance sufficient to cover the amount of the uncertainty.
8. When the strains are complex and of uncertain amount, such as those in the crankshaft of a reversing engine, a very high factor is necessary, possibly even as high as 40.
9. If the property loss caused by failure of the part may be large or if loss of life may result, as in a derrick hoisting materials over a crowded street, the factor should be large.

VIII. CONCLUSION

CAD combines the characteristic of designer and computer that are best applicable made CAD such as popular design tool. CAD Has allowed the designer to bypass much of the Manuel drafting and analysis . Simulation tools enable us to be creative and to quickly test new ideas that would be much more difficult, time-consuming, and expensive to test in the lab. (Jeffrey D. Wilson, Nasa Glenn Research Center) It also help us reduce cost and time-to-market by testing our designs on the computer rather than in the field. Many of the individual tasks within the overall design process can be performed using a computer. As each of these tasks is made more efficient, the efficiency of the overall process increases as well. The computer is well suited to design in four areas, which correspond to the latter four stages of the general design process; Computers function in the design process through geometric modeling capabilities, engineering analysis calculations, testing procedures, and automated drafting, From the result of the testing and the affordability in terms of cost, it can be concluded that the project is successful. Therefore software design should be encouraged in our institution of higher learning base on the following facts, long product development, countless trial and error, and accountability and limited profitability

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