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A CAMSHAFT FOR MULTI-CYLINDER ENGINE DESIGN

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ABSTRACT

The cam shaft and its associated parts control the opening and closing of the two valves. The associated parts are push rods, rocker arms, valve springs and tappets. It consists of a cylindrical rod running over the length of the cylinder bank with a number of oblong lobes protruding from it, one for each valve. The cam lobes force the valves open by pressing on the valve, or on some intermediate mechanism as they rotate. This shaft also provides the drive to the ignition system.

In this work, a camshaft is designed for multi cylinder engine and 3D-model of the camshaft is created using modeling software Solidworks with different materials aluminum alloy, forged steel &cast iron.

Present using the cast iron material for camshaft, we are replaced with aluminum alloy & forged steel.

Modeling done on Solidworks software.

INTRODUCTION

A cam is a rotating or sliding piece in a mechanical linkage used especially in transforming rotary motion into linear motion or vice versa. It is often a part of a rotating wheel (e.g. an eccentric wheel) or shaft (e.g. a cylinder with an irregular shape) that strikes a lever at one or more points on its circular path. The cam can be a simple tooth, as is used to deliver pulses of power to a steam hammer, for example, or an eccentric disc or other shape that produces a smooth reciprocating (back and forth) motion in the follower, which is a lever making contact with the cam.

Overview

The cam can be seen as a device that translates from circular to reciprocating (or sometimes oscillating) motion. A common example is the camshaft of an automobile, which takes the rotary motion of the engine and translates it into the reciprocating motion necessary to operate the intake and exhaust valves of the cylinders. The opposite operation, translation of reciprocating motion to circular motion, is done by a crank. An example is the crankshaft of a car, which takes the reciprocating motion of the pistons and translates it into the rotary motion necessary to operate the wheels.

Cams can also be viewed as information-storing and -transmitting devices. Examples are the cam-drums that direct the notes of a music box or the movements of a screw machine's various tools and chucks. The information stored and transmitted by the cam is the answer to the question, "What actions should happen, and when?" (Even an automotive camshaft essentially answers that question, although the music box cam is a still-better example in illustrating this concept.) Certain cams can be characterized by their displacement diagrams, which reflect the changing position a roller follower would make as the cam rotates about an axis. These diagrams relate angular position to the radial displacement experienced at that position. Several key terms

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are relevant in such a construction of plate cams: base circle, prime circle (with radius equal to the sum of the follower radius and the base circle radius), pitch curve which is the radial curve traced out by applying the radial displacements away from the prime circle across all angles, and the lobe separation angle (LSA - the angle between two adjacent intake and exhaust cam lobes). Displacement diagrams are traditionally presented as graphs with non-negative values. A camshaft is a shaft to which a cam is fastened or of which a cam forms an integral part.
The cam is driven by timing gears, chains, or belts located at the front of the engine. The gear or sprocket on the camshaft has twice as many teeth, or notches, as the one on the crankshaft. This results in two crankshaft revolutions for each revolution of the camshaft. The camshaft turns at one-half the crankshaft speed in all fourstroke-cycle engines.

CAMSHAFT FUNCTION

The camshaft's major function is to operate the valve train. Cam shape or contour is the major factor in determining the operating characteristics of the engine. The lobes on the camshaft open the valves against the force of the valve springs. The camshaft lobe changes rotary motion (camshaft) to linear motion (valves).
Cam lobe shape has more control over engine performance characteristics than does any other single engine part. Engines identical in every way except cam lobe shape may have completely different operating characteristics and performance. See Figure 9–1. The camshaft may also operate the following:

■ Mechanical fuel pump
■ Oil pump
■ Distributor

CAMSHAFT LOCATION

Pushrod engines have the cam located in the block.The camshaft is supported in the block by camshaft bearings and driven by the crankshaft with a gear or sprocket and chain drive. Many over

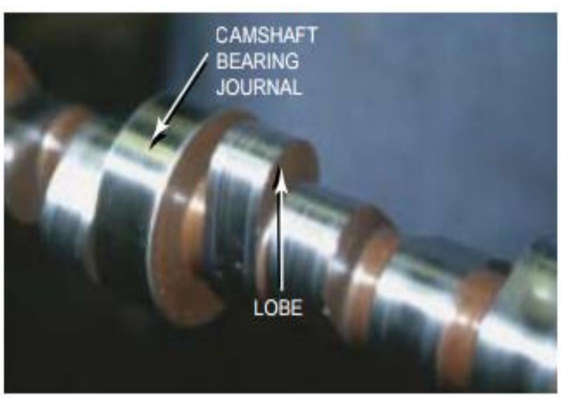

Fig1.1: cam journal bearing with lobe

This high-performance camshaft has a lobe that opens the valve quickly and keeps it open for a long time.
The camshaft is arguably the most complex component in an internal combustion engine1 and very few people know how they actually work. The function of the camshaft is to control the valve timing, ensuring that the valves open and close at the proper time to allow fuel and air to

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enter and exit the engine. The size, shape, and placement of all the eccentric bumps on the camshaft make the engine operate properly. Despite the complexity, camshaft terminology can be easily understood when absorbed in small pieces. This description will explain the basic principles of camshafts and the effects they have on overall engine performance.

History Camshafts have been used in internal combustion engines since 1876 when Nikolaus Otto invented the first successful four-stroke engine. This engine, although crude, is historically significant and was adopted as the standard design for future motored vehicles ("The History of the Automobile"). Today there are over 100 million cars on the road, all of which employ a camshaft to produce the power necessary for motion ("Commuting to Work"). The placement of the camshaft within the engine has changed numerous times throughout history. In recent memory, the pushrod and the overhead camshaft are the most common design types. Figure 1 shows a pushrod engine where the camshaft resides below and to the side of the combustion chamber. In this arrangement the camshaft moves lifters, which move pushrods, which rotate rocker arms, and finally open the proper valve as shown in the figure. Comparably, Figure 2 shows a single overhead camshaft design in which the camshaft is oriented directly above the combustion chamber, and directly moves the valves. Both camshafts are driven by the crankshaft with a timing chain (or in some cases a belt) and a series of gears. For the purposes of this discussion, pushrod engine characteristics will be reviewed, but these basics apply to any four-stroke engine, from a lawn mower to a racecar.

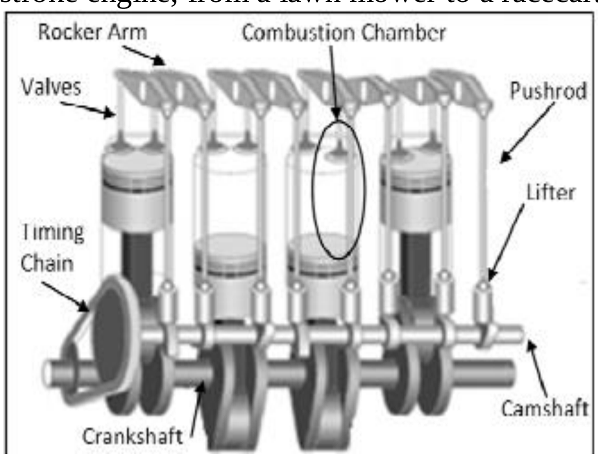

Fig1.2:Pushrod engine design.

The camshaft moves lifters, which move pushrods, which rotate rocker arms, and finally open the valves to initiate engine operation.

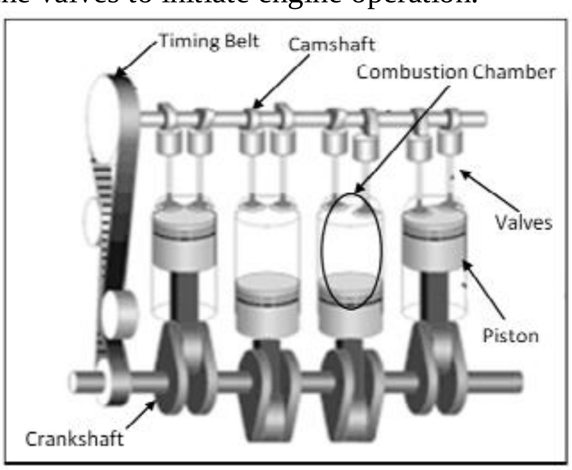

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Fig1.3:Overhead camshaft design.

The camshaft directly opens the valves to initiate engine operation

Lift The most basic aspect of a camshaft is lift. The shape of a typical camshaft lobe is shown in Figure 3. If you start with a circle and add a bump to a portion of that circle, you have created an eccentric. This is how the rotational motion of the camshaft changes into linear (up and down) movement to operate the valves.

Lift is defined as the difference in height between the radius of the base circle and the height of the eccentric as shown in below. In this figure, the value is 0.350-inch, which is defined as lobe lift. In a pushrod engine that consists of a rocker arm assembly, the rocker arm acts as a leverage arm, multiplying the lobe lift by a determined ratio. Referring back to Figure1.2, will give you a visual of what a normal rocker arm looks like. Typical rocker arm ratios are between 1.5:1 and 1.7:1. For example, a lobe lift of 0.350-inch with a 1.5:1 rocker arm ratio would produce a maximum valve lift of 0.525-inch (0.350 X 1.5 = 0.525).

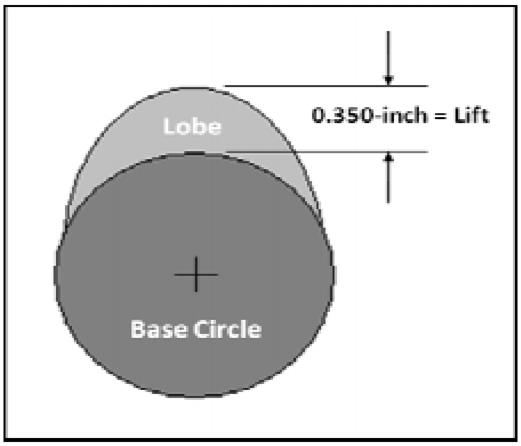


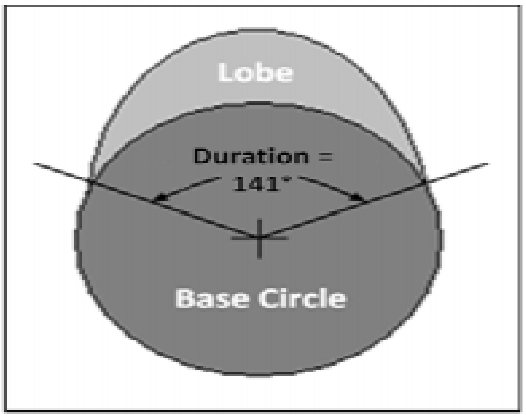
Fig1.4:lobe height

Lobe lift is the height of the eccentric rise over the radius of the base circle. In this case, the lift is 0.350-inch

Camshaft lift directly affects the power output of an engine. By increasing lift and opening the valves further, more flow area is provided to allow fuel and air to enter and exit the engine. All engines benefit from increased lift, but there are limitations to individual engine designs. Common factors limiting maximum lift are valve spring capabilities, rocker arm clearance, clearance between the valves and the pistons and durability issues. Increased lobe lift will increase the power output of an engine, but other camshaft characteristics also have an important effect on the power potential.

Duration

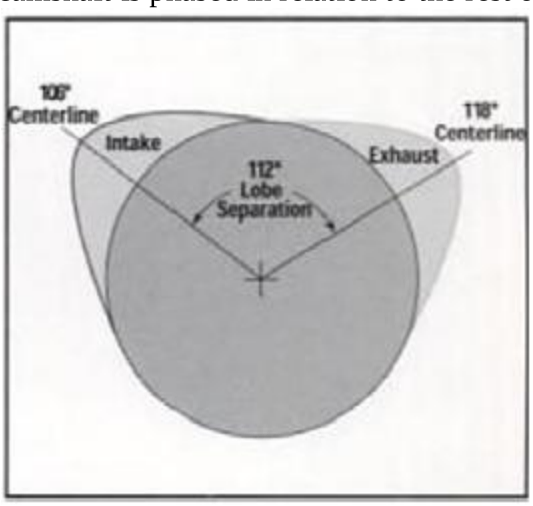
The amount of time (in degrees) that camshaft lift is generated is called the duration of the lobe. The camshaft lobe in Figure 4 has a duration of 141 degrees. Duration is simply the amount of time the camshaft is not on the base circle, but instead on the eccentric creating lift. All camshafts operate at half engine speed (half crankshaft speed), meaning that for one revolution of the camshaft, the crankshaft will have revolved two times. This relationship causes the duration seen in Figure 3 to be doubled, resulting in 282 degrees of actual duration for this particle camshaft lobe. Duration has a great effect on engine performance characteristics. A relatively small amount of duration will provide a smooth, crisp idle and excellent part-throttle operation. If the duration is increased, the intake valve is open for a longer period of time during the induction cycle2 . Added duration tends to reduce low-speed throttle response and power, but increases power at higher engine speeds. Huge amounts of duration cannot be obtained because duration is inversely proportional to engine vacuum. Engine vacuum is a measure of the amount of airflow restriction through an engine, and is vital to run accessories such as power brakes and cruise control. The ideal amount of duration depends a lot on the purpose of the engine. Performance applications will have relatively large amounts of duration, while towing vehicles will have small amounts.



Duration is the amount of time (in degrees) that camshaft lift is generated. In this case, the duration is 141 degrees

Centerlines

Centerline is the term used to determine the placement of the lobes both on the camshaft and in the engine. Each lobe of the camshaft has a centerline (or midpoint in its duration curve) as shown in Figure 4. This example shows an intake centerline of 106 degrees and an exhaust centerline of 118 degrees. Centerlines are important because they establish exactly where the camshaft is phased in relation to the rest of the engine to ensure proper valve timing.



Centerline is the term used to determine the placement of the lobes both on the camshaft and in the engine. The camshaft profile shown has an intake centerline of 106 degrees and an exhaust centerline of 118 degrees

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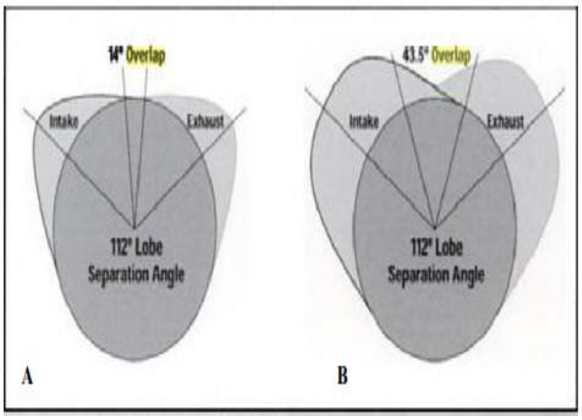
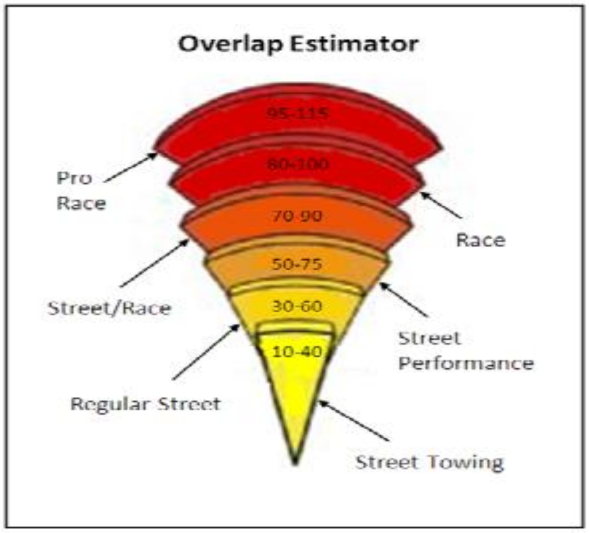
Lobe Separation Angle (LSA) and Overlap

Lobe separation angle (commonly referred to as LSA) is the dimension that specifies the distance or spread between the intake and exhaust centerlines. Calculating LSA is a simple procedure when lobe centerlines are known. For example, the profile in Figure 4 has an intake centerline of 106 degrees and an exhaust centerline of 118 degrees. Add the two centerline values and divide by 2 to get the lobe separation angle [(106 + 118) / 2 = 112 degrees LSA]. Lobe Separation Angle is very important because it establishes the amount of overlap between the intake and exhaust. Overlap is the amount of time (in degrees) that both the intake and exhaust valves are open in the cylinder. Figure 6 on the next page shows two different camshaft profiles with the same 112 degree LSA, but varying amounts of overlap. Camshaft B has more duration than Camshaft A, causing an additional overlap, 43.5 degrees versus 14 degrees, in order to maintain the same LSA. The figure makes this easy to understand. The larger or fatter lobes of B represent the higher duration and it is easily seen how this will increase the overlap.



Overlap is the amount of time (in degrees) that both the intake and exhaust valves are open. Camshaft B has more duration than Camshaft A, causing an additional overlap, 43.5 degrees versus 14 degrees, in order to maintain the same LSA

The correlation between camshaft centerlines, lobe separation angle, and overlap are a very important and difficult concept to understand. As the spread between the lobes tightens, the lobe separation gets smaller and overlap increases. A larger LSA means less overlap because the lobe centerlines are moving farther apart. This gets tricky because if you increase duration, this automatically increases the overlap with the same LSA. Big camshafts (high lift and duration) have wider lobe separation angles in an attempt to limit the amount of actual overlap between the two lobes. Lobe separation angle and overlap have great affects on engine performance and characteristics. Increasing the amount of overlap, or a small amount of LSA, raises the power curve to a higher rpm, while hurting power at low engine speeds.



Different amounts of overlap are designed into camshafts depending on the use of the engine. Large amounts of overlap are found in racecars.

Large amounts of (but not excessive) overlap is a prime key to large power output, but engine application will determine how much overlap can be tolerated. Figure 6 is a good estimator of the amount of overlap that is used in different situations. An all out racecar, for example, can handle 85-100 degrees of overlap, while a regular street engine should be between 30-60 degrees. This figure will help to define what overlap is expected in various vehicles.

LITERATURE REVIEW

Design and analysis of cam shaft for multi cylinder engine vulleruswamulu1 ,n.siva nagaraju2 , teege srinivas3

The cam shaft and its associated parts control the opening and closing of the two valves. The associated parts are push rods, rocker arms, valve springs and tappets. It consists of a cylindrical rod running over the length of the cylinder bank with a number of oblong lobes protruding from it, one for each valve. The cam lobes force the valves open by pressing on the valve, or on some intermediate mechanism as they rotate. This shaft also provides the drive to the ignition system. The camshaft is driven by the crankshaft through timing gears cams are made as integral parts of the camshaft and are designed in such a way to open and close the valves at the correct timing and to keep them open for the necessary duration. A common example is the camshaft of an automobile, which takes the rotary motion of the engine and translates it in to the reciprocating motion necessary to operate the intake and exhaust valves of the cylinders. In this work, a camshaft is designed for multi cylinder engine and 3D-model of the camshaft is created using modeling software pro/Engineer. The model created in pro/E is imported in to ANSYS. After completing the element properties, meshing and constraints the loads are applied on camshaft for three different materials namely aluminium alloy 360, forged steel and cast iron. For that condition the results have been taken has displacement values and von misses stresses for the static state of the camshaft. After taking the results of static analysis, the model analysis and harmonic analysis are done one by one. Finally, comparing the three different materials the best suitable material is selected for the construction of camshaft.

Static and harmonic analysis of cam shaft for multi cylinder engine VulleruSwamulu1 ,N.Siva Nagaraju2 , Teege Srinivas3

The cam shaft and its associated parts control the opening and closing of the two valves. The associated parts are push rods, rocker arms, valve springs and tappets. It consists of a cylindrical rod running over the length of the cylinder bank with a number of oblong lobes protruding from it, one for each valve. The cam lobes force the valves open by pressing on the valve, or on some intermediate mechanism as they rotate. This shaft also provides the drive to the ignition system. The camshaft is driven by the crankshaft through timing gears cams are made as integral parts of the camshaft and are designed in such a way to open and close the valves at the correct timing and to keep them open for the necessary duration. A common example is the camshaft of an automobile, which takes the rotary motion of the engine and translates it in to the reciprocating motion necessary to operate the intake and exhaust valves of the cylinders.

Camshaft design for a six-stroke engine mohdnurunnajmi bin amatjanji

An internal combustion engine generally utilizes a conventional four stroke process including an intake stroke, compression stroke, expansion stroke, and exhaust stroke and in addition to this four stroke process, adds a secondary process having two additional strikes for scavenging process employs a fresh air intake stroke and a fresh air exhaust stroke to exhaust any remaining burnt and unburnt gases from the combustion chamber. A six-stroke internal combustion engine with reciprocating pistons wherein the six strokes are the admission of air, the first compression accompanied or followed by a possible cooling, a second compression followed by a combustion, the first expansion producing also a usable work and finally the discharge of the combustion gases, this engine, whose combustion is either with gasoline version or diesel version will included preferably a multiple of five non-uniform cylinders, and will have an energy efficiency of up to 30% higher than that of a four-stroke internal combustion. This study was focused to fabricate the six-stroke engine camshaft by using the variety machining such as conventional lathe machine, milling machine and EDM wire cut.

Structural and modal analysis of camshaft karri anil1 ,dvsrbmsubhramanyam sharma2

The cam shaft and its related parts control the opening and closing of the two valves. It comprises of a cylindrical bar running over the length of the cylinder with a number of rectangle sections expanded from it, one for every valve. The cam projections make the valves open by pushing on the valve, or on some moderate component as they turn. This shaft additionally gives the drive to the ignition system. The camshaft is driven by the crankshaft over timing gears cams are made as indispensable parts of the camshaft and are designed in such an approach to open the valves at the right timing and to keep them open for the important span. An example is the camshaft of the vehicles, which takes the revolving movement of the engine and translates it in to the responding movement important to work the suction and exhaust valves of the cylinders. Material properties, lubrication system, system operating, and the mechanical contact stress are the factor influences the camshaft and its follower performance. The main aim of this work is to find the cam stress, strain and total deformation values. Then with the use of CATIA three-dimensional model of the cam shaft is obtained. Once the CAD model is obtained, modal analysis is performed on CAM SHAFT by applying Cast Iron material, Aluminium Alloy and Billet steel material.In this work, a camshaft is designed for multi cylinder engine and 3D-model of the camshaft is demonstrating using modeling software CATIA V5 R18. The model created in CATIA V5 R18 is transported in to ANSYS 14.5.

Design Optimization and Stress Analysis of Multicylinder Diesel Engine Crankshaft MallikarjunaNaraga1 ,Babu Uppalapti2

For every Internal combustion engine crank shaft plays the most important role in power transmission and one of the complicated components for effective and precise working of

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internal combustion engine, here the impact load will be applied on the crank shaft which leads to bend or crack the crank shaft. This can be reduced with the design modification. This paper involves in Design and Analysis of multi cylinder diesel engine crank shaft. Design of the crankshaft was done with the help of CATIA V5 R15 design software and the analysis was done with ANSYS software. The stress analysis of a 4-cylinder crankshaft are discussed using finite element method before and after modification in this paper Maximum stress areas and dangerous areas are found by the stress analysis of crankshaft and Deformation of the crank shaft for different materials. The Analysis was done before and after modification at stress concentrated areas with different loads by that the comparison was taken place. In the stress analysis we get the maximum stress values before and after modification. All the obtained values were plotted. Modifications are applied to reduce the stress of the crankshaft and by that the comparison was done with the previous design. By this the appropriate design optimization will be achieved.

INTRODUCTION TO CAD

Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

Its use in designing electronic systems is known as electronic design automation, or EDA. In mechanical design it is known as mechanical design automation (MDA) or computer-aided drafting (CAD), which includes the process of creating a technical drawing with the use of computer software.

CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce rastergraphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions.

CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called DCC digital content creation. The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.

The Foundation of Solidworks:

Solidworks is a computer graphics system for modeling various mechanical designs and for performing related design and manufacturing operations. The system uses a 3D solid modeling system as the core, and applies the feature-based, parametric modeling method. In

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short, Solidworks is a feature-based, parametric solid modeling system with many extended design and manufacturing applications.

3.2 Solidworks different from other CAD Systems:

Solidworks is the first commercial CAD system entirely based upon the feature-based design and parametric modeling philosophy. Today many software producers have recognized the advantage of this approach and started to shift their product onto this platform.

Nevertheless, the differences between a feature-based, parametric solid modeling CAD system, such as Solidworks, and a conventional CAD system include:

- Solidworks Conventional CAD Systems
- Solid Model Wireframe and Solid Model
- Parametric Model Fixed-dimension Model
- Feature-based Modeling Primitive-based Modeling
- A Single Data Structure and Full Function-Oriented Data Structures

Associativity with Format Interpreters

- Subject-oriented Sub-modeling Systems A Single Geometry-Based System
- Manufacturing Information Texts Attached to Geometry Entities
- Associated with Features
- Generation of an Assembly by Generation of an Assembly by
- Assembling Components Positioning Components

3.3 An Overview (by Parametric Technology Corp.):

(a) Ease of Use:

Solidworks was designed to begin where the design engineer begins with feature sand design criteria. Solidworks's cascading menus flow in an intuitive manner, providing logical choices and pre-selecting most common options, in addition to short menu descriptions and full on-line help.

This makes it simple to learn and utilize even for the most user. Expert users employ Solidworks's "map keys" to combine frequently used commands along with customized menus to exponentially increase their speed in use. Because Solidworks provides the ability to sketch directly on the solid model, feature placement is simple and accurate.

(b) Full Associatively:

Solidworks is based on a single data structure, with the ability to make change built into the system. Therefore, when a change is made anywhere in the development process, it is propagated throughout the entire design-through-manufacturing process, ensuring consistency in all engineering deliverables.

(c) Parametric, Feature-Based Modeling:

Solidworks's features are process plans with imbedded intelligence and are easy to use, while at the same time, powerful enough to fillet, round, and shell even the most complex geometry. These features contain non-geometric information, such as manufacturing processes and associated costs, as well as information about location and relationships.

This means that features do not require coordinate systems for placement, and they "know" how they are related to the rest of the model. As a result, changes are made quickly and always adhere to the original design intent.

(d) Powerful Assembly Capabilities:

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Assembling components is easy with Solidworks simply tell the system to "mate," "insert," or "align" the components and they are assembled, always maintaining the design intent. Also, the components "know" how they are related, so if one changes, either positional or geometrically, the other will change accordingly. Parts can be designed right in the assembly and defined by other components, so if they move or change size, the part will automatically update to reflect the change.

(e) Robustness:

The Solidworks family of products is based on a double precision, no facetedsolid modeling core. This provides the engineer with the most accurate representation of geometry, mass properties, and interference checking available.

(f) Change Management:

Powerful change capabilities are inherent with Solidworks full associatively, enabling design-through-manufacturing disciplines to execute their functions in parallel. Tools for parametric data management successfully manage these simultaneous processes and promote an organized, controlled workflow.

(g) Hardware Independence:

Solidworks runs on all of the major UNIX and WindowsNTplatforms, maintaining the same look and feel on every system. Users can select the most economical hardware configuration for their needs, and mix and match any combination of platforms. Information can be easily exchanged from one machine to the other, with Solidworks managing any architectural differences.

3.4 Solidworks Functionality

The basic functionality of Solidworks is broken into several areas:

(a) Part Design

Create sketched features including protrusions, cuts, and slots made by either extruding, revolving sweeping along a 2D sketched trajectory, or blending between parallel sections

Create "pick and place" features, such as holes, shafts, chamfers, rounds, shells, regular drafts, flanges, ribs, etc.

Sketch cosmetic features

Reference datum planes, axes, points, curves, coordinate systems, and graphs for creating on-solid reference datum Modify, delete, suppress, redefine, and reorder features, as well as making features "read-only" Create table-driven parts by adding dimensions to the family table Capture design intent by creating relations between part dimensions and parameters Generate engineering information, including mass properties of parts, model cross sections, and reference dimensions Create geometric tolerances and surface finishes on models Assign density, units, material properties or user-specified mass properties to a model Additional functionality available through Solidworks/FEATURE.

(b) Assembly Design:

Place components and subassemblies using commands like mate, align, and insert to create full product assemblies Disassemble components from an assembly Modify assembly placement offsets Create and modify assembly datum planes, coordinate systems, and cross sections Modify part dimensions in assembly mode Generate engineering information, bills of materials, reference dimensions, and assembly mass properties Additional functionality available through Solidworks/ASSEMBLY.

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(c) Design Documentation (Drawings):
Create numerous types of drawing views, including general, projection, auxiliary, detailed, exploded, partial, area cross-section, and perspective.
Perform extensive view modifications, including changing the view scale and the boundaries of partial or detailed views, adding projection and cross-section view arrows, and creating snapshot views.
Create drawings with multiple models, delete a model from a drawing, set and highlight the current model of a drawing. Use a sketch as a parametric drawing format
Manipulate dimensions, including show, erase, switch view, flip arrows, move dimensions ,text, or attach points Modify dimension values and number of digits Create, show, move, erase, and switch view for standard notes Include existing geometric tolerances in drawing notes Update the model geometry to incorporate design changes Export a drawing IGES file Mark-up drawings to indicate changes to be made Additional functionality available through Solidworks/DETAIL.
(d) General Functionality
Database management commands. Layer control for placing items on a layer and displaying layers. Measuring commands for distance, geometric information angle, clearance, and global interference on parts and assemblies. Viewing capabilities to pan, zoom, spin, shade, and re-orient models and drawings.

3.5 The Function Modules of Solidworks:

The core of Solidworks is the feature-based, parametric solid modeling system for modeling mechanical parts. The part model created by this system can be used to form mechanical assemblies and to produce engineering drawings.

The model can also be used to carry out other related manufacturing activities such as the generation of CNC tool paths and Bills of Material.
These extended functions are reflected by the following Solidworks modes:
Mode Description

Sketcher Sketch feature sections and parametric drawings. This mode can be accessed directly from the MODE menu as well as from the Part and Assembly modes.
Part:Create the solid model of a part.
Assembly: Form the solid model of an assembly of multiple components.
Drawing:

Produce engineering drawings of parts and assemblies created in Solidworks. These drawings are fully associative with the 3D solid model. When a dimension in the drawing is changed the dimension of the associated 3D model(s) will be automatically updated, and vice versa.
Manufacture:
Define the machining operations that are required to manufacture a part modeled
Using Solidworks. These are frequently used Solidworks modes. Other Solidworks modes include:
Mode Description:
Cabling Accessed from within Assembly mode, it is used to route cables between connectors and other electrical terminators (with Solidworks/CABLING).
Cast Design die assemblies and prepare castings for manufacturing (with Solidworks /CASTING).

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Composite Create and document parts made of composite materials (with Solidworks /COMPOSITE).

Diagram:

Create 2-D schematic representations of electrical, piping, power, heating and ventilation assemblies (with Solidworks /DIAGRAM).

Die face Design and analyse the contact surfaces of stamping dies for forming deep drawn sheet metal parts (with Solidworks/DIEFACE).

Format Create and modify drawing formats used by other Solidworks products (with Solidworks/DETAIL).

Interchange Create an object called an "interchange group", providing the ability either to automatically exchange functionally-equivalent members in an assembly or to substitute simplified versions of members in an assembly.

Layout Create 2-D conceptual assembly sketches (with Solidworks /NOTEBOOK).

Legacy Import 3D data and 2D drawings into Solidworks from other CAD products and update these using optimized tools to work with wireframe, surface, and 2D data (with Solidworks /LEGACY).

Mark-up:

Mark up a drawing, part, or assembly without changing the object itself (with basic Solidworks).

Mold:Create and analyse molds and moldings (with Solidworks /MOLDESIGN).

Preprocessor:Set up CL Data Post Processor

Process:Create or modify process assemblies

Report:Create custom reports for assembly Bills of Material and Project Engineering Change Orders (with Solidworks/REPORT).

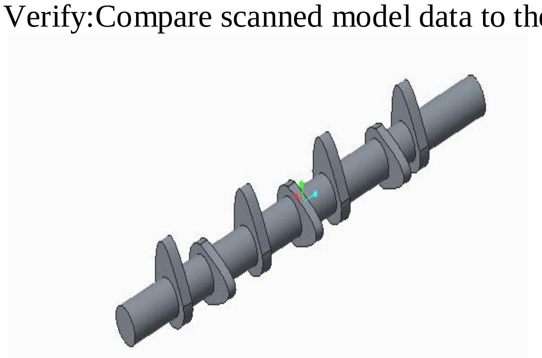
Scan Model:

Create or dynamically modify surfaces using an array of scanned point data (With Solidworks /SCAN-TOOLS).

Sheet Metal:

Create solid models of sheet metal parts and develop the NCL data necessary to manufacture them (with Pro/SHEETMETAL).

Verify:Compare scanned model data to the design model.



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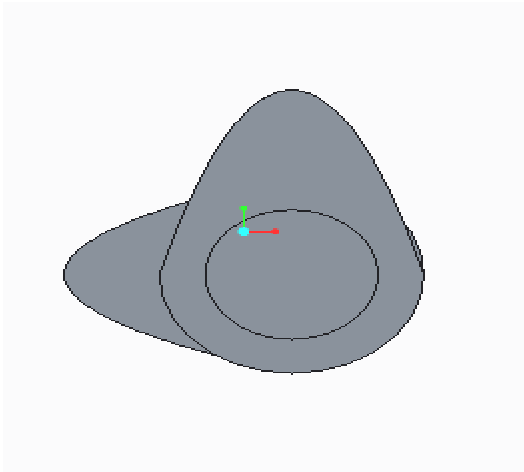

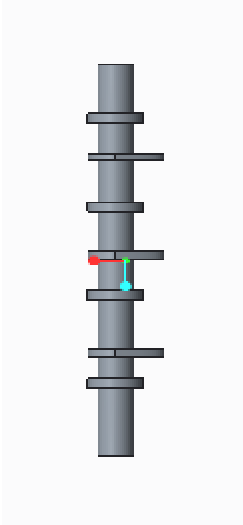

Conclusion

In this project v6 engine camshaft was developed by using cad tool solid works, by using real time calculations here object were developed in solid works, and after developing this camshaft in this thesis material properties discussed, from the research here we came to know that forged steel is consider as existing material to improve the efficiency and strength of the model here another materials which are compositions of steel were using.

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