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Modelling and Analysis of Main Shaft of a Two Wheeler

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ABSTRACT

This study delves into the critical examination of weight and cost reduction strategies for the Main Shaft, a vital component within the framework of internal combustion engines for two-wheelers. Employing SolidWorks for modeling and ANSYS Workbench for optimization, the research pursues a comprehensive modularization study. This entails fine-tuning geometry, material selection, and manufacturing processes with due consideration to unique constraints and cost implications. The investigation incorporates three distinct materials - aluminum, structural steel, and magnesium alloy - subjected to ANSYS Workbench analysis to discern their individual performances under specified conditions. The goal is to identify the most efficient material that achieves optimal weight reduction and cost-effectiveness in the design of the Main Shaft.

Keywords: Main Shaft, Internal Combustion Engine, Optimization, Design, SolidWorks, ANSYS Workbench

1. INTRODUCTION

The early history of the automobile can be divided into several eras, based on the prevalent means of propulsion. Later periods were defined by trends in exterior styling, size, and utility preferences. In 1768, the first steam powered automobile capable of human transportation was built by Nicolas-Joseph Cugnot In 1807, François Isaac de Rivaz designed the first car powered by an internal combustion engine fueled by hydrogen. In 1886, the first petrol or gasoline powered automobile, was invented by Karl Benz This is also considered to be the first "production" vehicle as Benz made several other identical copies. At the turn of the 20th century electrically powered automobiles appeared but only occupied a niche market until the turn of the 21st century. In modern world the living status were developed and developing more equipped. The automobile takes a great part in the development, since it plays one of a major key in daily life.

1.1.1 General Classification of Automobiles

The different types of automobiles found on roads are presented in Chart in a comprehensive manner. There are in general three main classifications of the various types of vehicles. They are:

- The single-unit vehicles or load carriers.
- The articulated vehicles.

- The heavy tractor vehicles.

1.1.2 The Single-Unit Vehicles or Load Carriers

These vehicles are conventional four-wheel types with two-axle design in which the front axle is a steering non-driving axle, and the rear axle is the driving axle. With the advancement, many changes have been incorporated in the number of axles as well as the driving system.

1.1.3 The Articulated Vehicles

A larger powered three-wheeler with single steering wheel in front and a conventional rear-driving axle falls in this category. It can be turned about its own tail due to the three-wheel construction and has a greater handling ability in unusual places. The coupling mechanism between semi-trailer and tractor in most of these vehicles is designed for automatic connection\and coupling up. A lever is provided within the driver's approach or coupling operation. A pair of retractable wheels in front can be raised or lowered automatically along with the coupling and uncoupling operation.

1.1.4 The Heavy-Tractor Vehicles

To move heavy loads tractor or independent tractor vehicles are used. They commonly operate in pair either in tendon or as puller or pusher. The latter arrangement provides stability while descending appreciable gradients. The digital figures like 4×2, 4×4, 6×4 etc. are commonly used in the classification of vehicles, where the first figure represents the total number of wheels and the second figure the number of driving wheels. By increasing the number of axles, the load per axle can be reduced which protects the type from overloading and the road surface from damage..

1.2 PINION FAILURE AND DATA COLLECTION

A single-stage helical reduction gearbox was employed in a kraft process plant to reduce the speed (8350 rpm) of a steam turbine to operate an alternator at a speed of 1500 rpm, such that electricity (3 MW) would be generated for use in the plant. This corresponds to pinion and gear speeds of 8350 rpm and 1500 rpm, respectively. The gearbox was intended to operate continuously for 20 years (excluding break periods for maintenance). The data pertaining to the pinion and gear were measured/collected at the site of gearbox failure, which are listed in Table 1. The photographic view of the helical gearbox is shown in Figure 1 along with the names of key components. However, Figure 2a shows the key dimensions of the pinion and gear of the helical gearbox. Moreover, the photographic view of pinion is also shown in Figure 2b for its geometrical visual to the readers. Because of the requirement of greater electricity generation in the plant, the reduction gearbox was operated at 3.75 MW (instead of 3 MW) with the permission of the gearbox designer. However, when the gearbox was operated at high load (3.75 MW), the pinion teeth became plastically deformed near the thrust disc.

Fig.no.1.1 rock and pinion

1.3 TRANSMISSION GEAR & SHAFT ASSEMBLY (SHIFT GEAR MECHANISM)

Musashi India manufactures lightweight, premium quality and best cost transmission gear & shafts for the two-wheeler OEMs using precision net shape forging and machining capabilities. With our integrated production systems, we deliver value and supply transmission assemblies to our customers, ensuring functional performance. Musashi is the most experienced and the largest two-wheeler transmission gear and shaft supplier in India. Musashi provides in-depth product support to prospective OEM clients based on its vast industry experience and expertise.

Fig.No.1.2 Transmission Gear & Shaft

1.5 TRANSMISSION GEAR AND SHAFTS (FOR SCOOTERS)

We are catering to the growing, demanding and developing scooter market of India with our net shape forging, precision machining and integrated production systems.

Fig.no.1.3 Scooter gears

1.6 CAMSHAFTS & OTHER PARTS

Utilizing the accumulated designing, forging and machining know-how we supply critical parts like camshafts, kick assembly, one-way clutch to the two-wheeler OEMs.

Fig.no.1.4 cam shafted gear

2. LITERATURE REVIEW

Gearboxes are widely employed for mechanical power transmission in automobiles, windmills, machine tools, plant machinery, and many other mechanical systems. Enhancement and reduction of the speed of the output shaft are achieved using gearboxes at reduced and increased torques, respectively. From the economical perspectives, the efficient and reliable functioning of gearboxes of machinery is extremely vital. The failure of gearboxes in industrial plants can cause malfunction in machinery, which leads to production loss, a costly affair in terms of loss of profit. It also involves the additional cost of repair/replacement of failed gears. It is worth noting here that gear failure may occur due to design error, manufacturing error (e.g., poor machining, faulty heat treatment of parts, poor gear-set assembly), or improper installation and/or operation. Design errors mainly include improper gear geometry, poor selection of materials, and inadequate lubrication arrangement [1,2]. However, improper installation and operation involves faulty mounting, inadequate cooling, improper lubrication, and poor maintenance [3–6]. When errors are present, as described in the previous paragraph, gears fail and show the symptoms of scoring, wear, pitting, plastic flow, and teeth breakage/fracture. Scoring occurs because of lubrication failure, which causes asperity-to-asperity to contact between the teeth of the pinion and gear [7–9]. This results in micro-welding at the tip of the asperity followed by tearing, which leads to the continuous and rapid removal of material from the teeth surface. However, wear is a type of damage that occurs owing to the progressive removal of material from the interacting surfaces. Material removal in wear may be due to adhesion, abrasion, corrosion, or a combination of these. Wear causes increased surface roughness, enhanced clearance at the mating interface, and weakened teeth. Pitting occurs at the gear teeth surface because of repeated loading those results in the contact stress exceeding the surface fatigue strength of the material. Pitting failure takes place over millions of cycles of gear revolutions. During the pitting process, if material is removed from the mating surfaces of teeth in the form of a flake, it is called flaking/spalling. High contact stresses at the interfaces of teeth under rolling/sliding motion can cause the plastic flow of teeth surfaces as well. This type of failure is normally found in softer gear materials. Moreover, teeth fracture/breakage also takes place because of high overload arising from either impact loading or static load itself [10,11].

In many situations, the inspection of failed parts and analysis of data do not provide information regarding the cause of gear failure. In this case, gear design checks and laboratory tests are required to develop an understanding on the probable cause(s) of failure. It has been reported that if failure is influenced by the gear geometry, then checking for design and metallurgical defects should be performed. It is always recommended to perform non-destructive tests (e.g., measuring the surface hardness and roughness, magnetic particle inspection, acid etch inspection, gear tooth accuracy inspection) before performing any type of destructive tests (e.g., micro-hardness measurement, microstructural determination using acid etches, determination of grain size, inspection for non-metallic inclusions, SEM microscopy) on failed gears/components. Over the past several years, analyses have been conducted on the failure of gears of different mechanical systems. It has been reported that most gear failures have occurred because of manufacturing and operational errors of gears and gearboxes, respectively [12–18]. However, bending fatigue [19,20], wear and surface contact fatigue [21,22], and design faults [23,24] have also contributed significantly to failure. Based on the literature review, it is found that there is no published work regarding the failure analysis of high-speed helical gearbox (pitch velocity of pinion > 55 m/s) having provision of axial thrust sustaining between a disc mounted on the pinion and the blank of gear. Therefore, the objective of this paper is to investigate the failure of pinion teeth of a helical reduction gearbox used in craft process. It is understood that the information provided in this paper may be useful to practicing engineers and researchers.

3. OVERVIEW OF COMPONENT

"Module" is the unit of size to indicate how big or small a gear is. Is is the ratio of the reference diameter of the gear divided by the number of teeth.

Thus: $m = \frac{d}{z} (Module = \frac{Reference\ \ diameter}{Number\ \ of\ \ teeth})$

The mutual relation between the module and the reference diameter etc. is as follows.

Reference diameter d=mz (Reference diameter = Module * Number of teeth)

Thus: $z = \frac{d}{m} (Number\ of\ teeth = \frac{Reference\ \ diameter}{Module})$

Reference pitch p=πm (reference pitch =π*module)

While using chain drive in two-wheeler, there possess some noise and greasy and wear over the chain that leads to high maintenance cost. So, this can be prevented by this type of arrangement as output shaft of the gear box is connected to a propeller shaft through a set of bevel gears. The other side of the shaft relates to another set of bevel gears. These bevel gears are used to rotate the back wheel parallel to the engine shaft. The power from the engine is transmitted to the gear box whenever required. The transmitted power from the engine is made to flow over the output shaft of the gear box which is connected to bevel gear which is meshed with another bevel gear that transmits power from one another. The bevel gear which is connected to propeller shaft transmits power to the other end of bevel gear that is meshed up with another bevel gear which relates to the axle, so the power transmitted from gear to axle. The wheel is connected to the axle which rotates the wheel in a forward direction. Thus, the power is transmitted from engine to the rear wheel with the help of the bevel gears and shaft.

Fig.no.3.1 block diagram

The above figure represents the block diagram of the power transmission from engine to the rear wheel using shaft drive mechanism.

3.1 Assembly

- The Engine gear box shaft is connected to a bevel gear which is in turn meshed with a bevel gear attached to main shaft (propeller shaft) and hence provides for perpendicular transmission.
- The other side of the propeller shaft relates to bevel gears. This in turn meshes with the bevel gear attached to the rear wheel shaft.
- Alignment bearing supports the shaft at the center. The Bearing constrains relative motion to only the desired motion and provides for frictionless motion.
- The bearings case is welded to the frame of two-wheeler.
- A universal coupling is fitted at the left end and right of the shaft to accommodate the bends in the shaft due to the suspension action of the shocks produced due to uneven path.
- Two bearings are also fitted at the ends of the rear wheel shaft to allow its smooth rotation without friction.

3.2 Advantages

The advantages of using this shaft drive instead of chain drive are as follows.

- They have good corrosion resistance and high strength.

- Higher efficiency as compared to the chain drive.
- Greater torque capacity than the chain drive.
- Longer fatigue life than chain drive.
- Shaft drives operate at a very consistent rate of efficiency and performance, without adjustments or maintenance.
- Standard chain drives are noisy, require more frequent maintenance to keep the chain from corroding, wearing, and from frictional wear of the sprockets.
- Provides greater ground clearance.

4. INTRODUCTION TO CAD

Computer Aided Drafting is the process of preparing a drawing of an object on the screen ofa computer.Therearevarioustypesofdrawingsindifferentfieldsofengineeringandsciences. Inthefieldsofmechanicaloraeronauticalengineering,thedrawingsofmachinecomponents andthelayoutsofthemareprepared.Inthefieldofcivilengineering,plansandlayoutsofthe buildingsareprepared.Inthefieldofelectricalengineering,thelayoutsofpowerdistribution systems are prepared. In all fields of engineering use of computers is made for drawing and drafting.

The use of CAD process provides enhanced graphics capabilities which allows anydesigner to

- Conceptualize hisideas.
- Modify the design veryeasily.
- Performanimation.
- Make designcalculations.
- Use colors, fonts and other aestheticfeatures.

4.1 CAD

4.1.1 Reasons for Implementing a Cad System

Increases the productivity of the designer: CAD improves the productivity of the designer to visualize the product and its component parts and reduces the time required in synthesizing, analyzing and documenting thedesign. Improvesthequalityofthedesign:CADsystemimproves thequalityofthedesign. A CAD system permits a more detailed engineering analysis, and a larger number of design alternatives can be investigated. The design errors are also reduced because of the greater accuracy provided by thesystem. Improves communication: It improves communication in design. The use of a CAD system provides better engineering drawings, more standardization in the drawing, betterdocumentationofthedesign,fewdrawingerrorsandlegibility. Create database for manufacturing: In the process of creating the documentation fortheseproducts,muchoftherequireddatabasetomanufacturetheproductsisalsocreated. Improves the efficiency of the design: It improves the efficiency of the design process and the wastage at the design stage can bereduced.

4.1.2 Application of Cad

There are various processes which can be performed by use of computer in the drafting process. Automated drafting: This involves the creation of hard copy engineering drawings directly from CAD database. Drafting also includes features like automatic dimensioning, generation of cross – hatched areas, scaling of the drawing and the capability to develop sectional views and enlarged views in detail. It can perform transformations of imagesandprepare3Ddrawingslikeisometricviews,perspectiveviewsetc., Geometric modeling: concerned with the computer compatible mathematical description of the geometry of an object. The mathematical description allows the image of an object to be displayed and manipulated on a graphics terminal through signals from the CPUoftheCADsystem.Thesoftwarethatprovidesgeometricmodelingcapabilitiesmustbe designedforefficientusebothbythe computerandthehumandesigner.

4.1.3 Benefits of Cad

The implementation of the CAD system provides variety of benefits to the industries in design and production as given below:

- Improved productivity indrafting
- Shorter preparation time fordrawing
- Reduced manpowerrequirement
- Customer modifications in drawing areeasier.
- More efficient operation indrafting
- Low wastage indrafting
- Minimized transcription errors indrawing.
- Improved accuracy ofdrawing
- Assistance in preparation ofdocumentation

- Better designs can beevolved.
- Revisions arepossible.
- Colors can be used to customize theproduct.
- Production of orthographic projections with dimensions andtolerances
- Hatching of all sections with different fillingpatterns
- Preparation of assembly or sub assemblydrawings
- Preparation of partlist
- Machining and tolerance symbols at the requiredsurfaces
- Hydraulic and pneumatic circuit diagrams withsymbols
- Printing can be done to anyscale.

4.1.4 Limitations of Cad

- 32 – bit word computer is necessary because of large amount of computer memory andtime.
- The size of the software package islarge.
- Skill and judgment are required to prepare thedrawing.
- Hugeinvestment.

4.1.5 Cad Software's

The software is an interpreter or translator which allows the user to perform specific types of application or job related to CAD. The following software's are available for drafting.

- AUTOCAD
- Pro –E
- CATIA
- MSOFFICE
- PAINT
- ANSYS
- MSc. NASTRAN
- IDEAS
- SOLID WORKS
- HYPERMESH
- FLUENT –GAMBIT
- The above software is used depending upon their application.

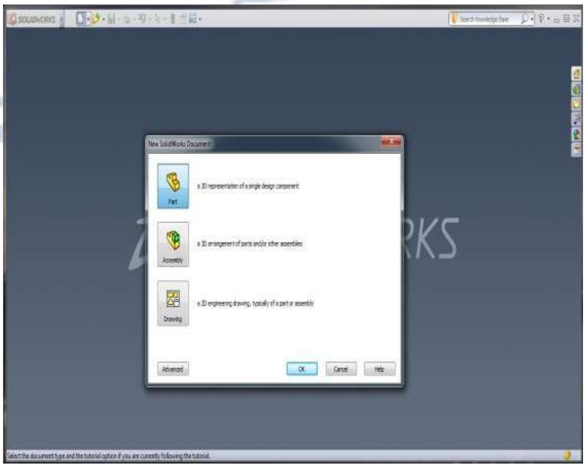
4.2 INTRODUCTION OF SOLIDWORKS

SolidWorks is a solid modeling computer-aided design (CAD) and computer-aidedengineering(CAE) computer program that runs on Microsoft Windows. SolidWorks is published by Dassault systems.More than 3,246,750 product designers and engineers worldwide, representing 240,010 organizations, use SOLIDWORKSto b r i n g their designs to life–from the coolest gadgets to innovations that deliver a bettertomorrow. Dassault systems SOLIDWORKS Corp. offers complete 3D software tools that let you create, simulate, publish, and manage your data. SOLIDWORKS products are easy to learn and use and work together to help you design products better, faster, and more cost-effectively. SOLIDWORKS'focus on ease-of-use allowsmore engineers, designers and other technology professionals than ever before to take advantage of 3D in bringing their designs tolife.

- It is headquartered at Waltham, Massachusetts, USA.
- The latest version of SolidWorks was released on 19thSeptember, 2016 as SolidWorks 2017.
- SolidWorks partners with third party developers toadd functionality in niche market applications likefinite element analysis, circuit layout, tolerance checking, etc. SolidWorks has also licensed its 3D modelingcapabilities toother CAD software vendors, notablyANVIL.

SolidWorks Corporation was founded in December 1993 by Massachusetts Institute ofTechnology graduate Jon Hirschtick.Hirschtickused $1 million he had made while a member of the MIT Blackjack Team to set up the company. Initially based in Waltham,Massachusetts,United States, Hirschtickrecruited a team of engineers with the goal of building 3D CAD software that was easy-to-use, affordable, and available on the Windows desktop. Operating later from Concord, Massachusetts, SolidWorks released its first product SolidWorks 95, in November 1995. In 1997 Dassault, best known forits CATIA CAD software, acquired SolidWorks for $310 million in stock.

4.3 THE SOLIDWORKSMODEL

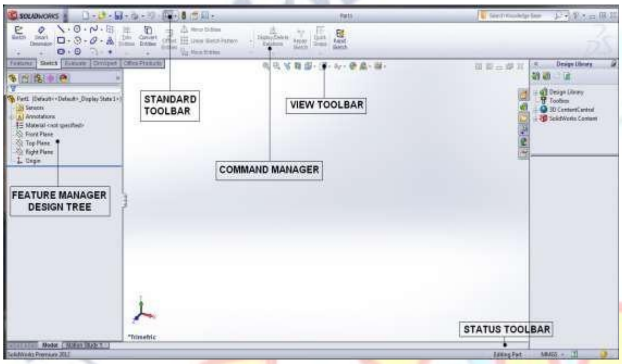


The SolidWorks model is made up of:

- Parts -2D design (Sketch), 3D design (Features) , Part design consider in the part designsection.
- Assemblies - Assembling of two or more than two parts considered in thissection.
- Drawings - Designing with standards is considered in the drawingsection.

4.4 SOLIDWORKS USERINTERFACE

The interface is native Windowsinterface, and such behaves in the same manner as other Windowsapplications.



4.4 Design of Main shaft of a two-wheeler

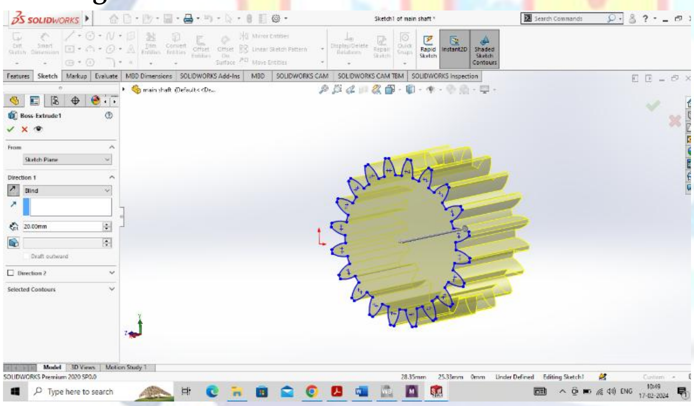


FIG.4.1 Extrude boss 1

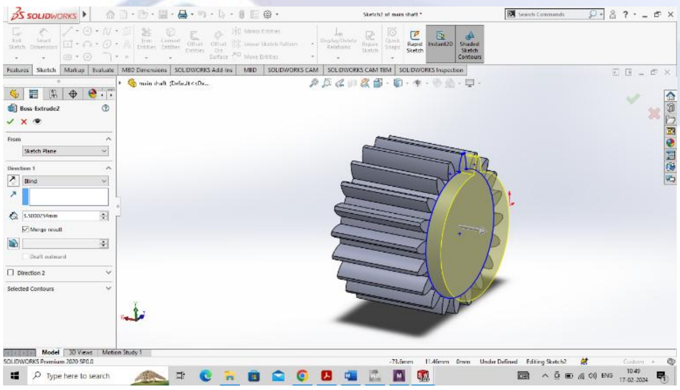


FIG.4.2 Extrude boss 2

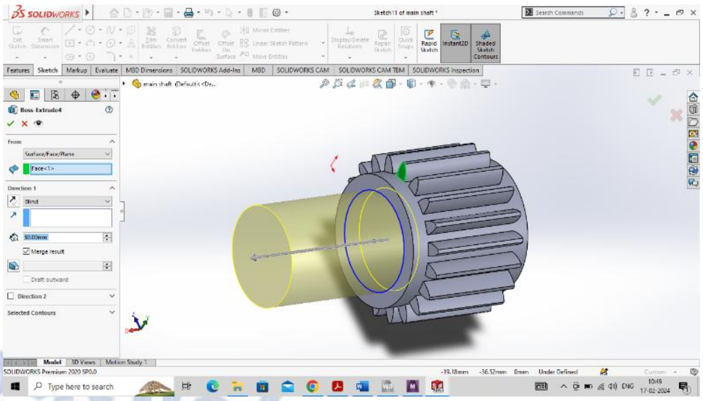


FIG.4.3 Extrude boss 3

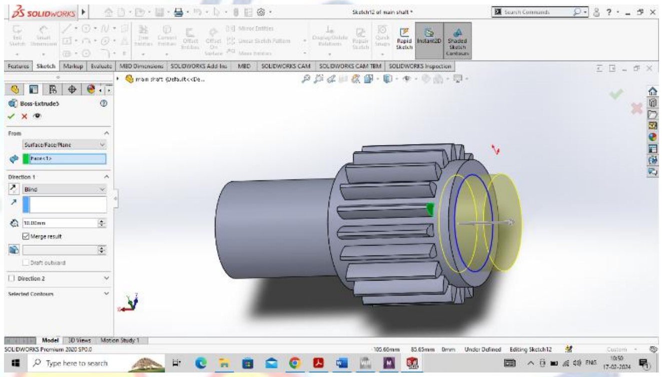


FIG.4.4 Extrude boss 4

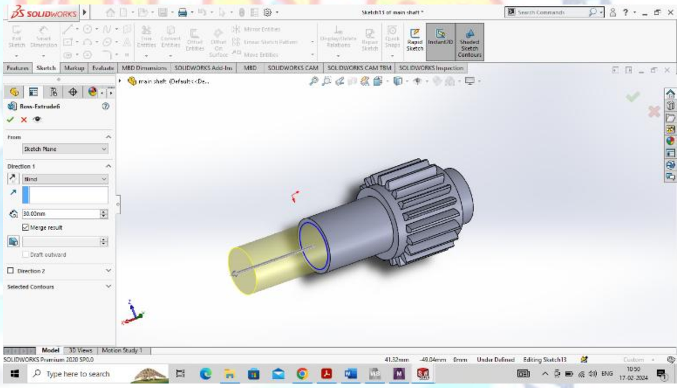


FIG.4.5 Extrude boss 5

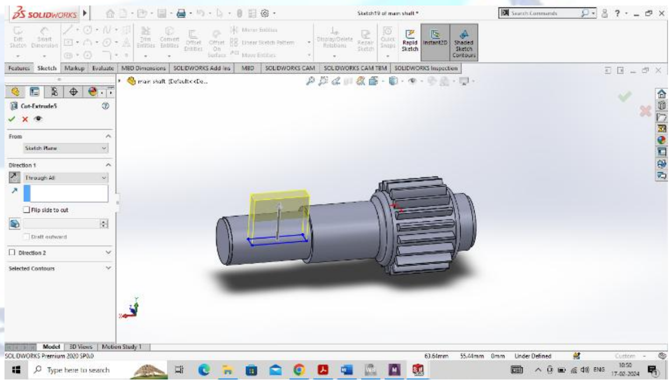


Fig.4.6 extrude cut

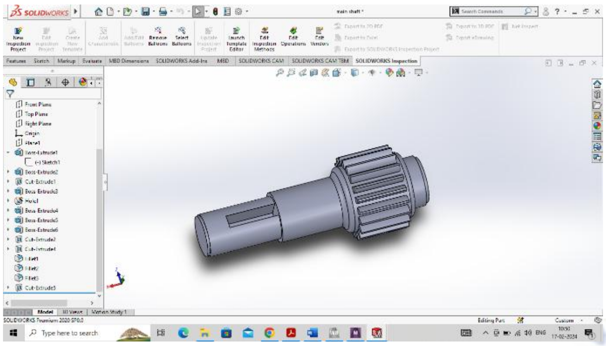


Fig.4.7 design of two-wheeler main shaft

5. ANALYSIS

5.1 INTRODUCTION TO FINITE ELEMENT ANALYSIS

The essential idea in fem is that the body or structure may be separated into littler components of limited measurements called "Finite Elements". The first body or the structure is then considered as a gathering of these components associated at a limited number of joints called "nodes" or "nodal points". Basic capacities are approximated the relocations over each limited component. Such accepted capacities are called "shape capacities". This will speak to the uprooting within the component as far as the remit Element technique is a scientific apparatus for illuminating common and fractional at the hubs of the components. The Final differential comparison in light of the fact that it is a numerical instrument, it can take care of the unpredictable issue that can be spoken to in differential mathematical statement from. The use of FEM is boundless as respects the arrangement of commonsense configuration issues. FEM has good efficiency to solve problems and cost critical problems as the cost for computing power is high.

The finite element method can be utilized to solve problems in the following areas:

- Structural analysis
- Thermal analysis
- Vibrations and dynamics
- Buckling analysis
- Acoustics
- Fluid flow simulations
- Crash simulation.
- Mould flow simulations

Now a days, even the simplest of products rely on the finite element method for design evaluation. This is on account of contemporary configuration issues normally can't be understood as precisely and inexpensively utilizing some other system that is at present accessible. Physical testing was the standard in the years passed by, however now it is just excessively costly and tedious too.

Who?

The reference credited is to Courant (Mathematician), Turner (air craft industry), Clough (California University), Martin (air craft industry), Argyris (German university), etc. However, it was probably established by several pioneers independently.

When?

- Initial idea in mathematical terms was put in 1940s.
- Application to simple engineering problems in 1950s.
- Implementation in large computers in 1960s.
- Development of pre and post processors in 1980s.
- Analysis of large structural problems in 1990s.

Where?

Implementation and application were mainly in aircraft industry and automobile sectors (large and fast computers were available only in these industries).

What?

Field problems in the form matrix of organizing large numbers of algebraic equations are used and matrix equations are solved. Differential equations are changed into an algebraic form. Blocks with different geometry are hooked together for creating complex geometry of the engineering problem.

Why?

The advantage of doing FEM analysis is that it is simple to change the geometry, material and loads recomputed stresses for modified product rather than build and test. The method can be used to solve almost any problem that can be formulated as a field problem. The entire complex problem can be cast as a larger algebraic equation by assembling the element matrices within the computer and solved.

5.2 MESHING:

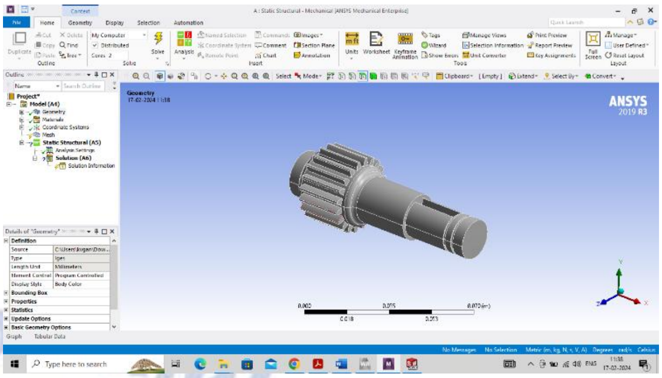
Before lattice the model and even before building the model, it is essential to consider whether a free work or a mapped cross section is proper for the examination. A free work has no limitations as far as component shapes and has no predefined example connected to it. Contrast with a free work, a mapped cross section is confined as long as the component shape it contains and the pattern of mesh. Mapped area mesh contains either quadrilateral or just triangular components, while a mapped volume cross section contains just hexahedron components. If we need this kind of lattice, we must form geometry as an arrangement of genuinely normal volumes and/or regions that can acknowledge a mapped network.

5.3 STRUCTURAL STATIC ANALYSIS:

The load effects can be calculated on a structure by ignoring the damping and inertia effects, such as those caused by time varying loads can be calculated by structural static analysis. Steady equivalent loads like steady inertia loads and time varying loads are included in Static analysis. Static analysis is utilized to decide the removals, burdens, strains and powers in structures or segments brought about by burdens that don't instigate noteworthy dormancy and damping impacts. Enduring stacking and reaction conditions are accepted, i.e. the stress and the structure's reactions are expected to differ gradually as for time. The kinds of load can be applied in static analysis include:

- Force and pressure application on body.
- Steady state inertial forces.
- Displacement.
- Thermal behavior.
- 6.4 Analysis Steps:
- The steps needed to perform an analysis depend on the study type. You complete a study by performing the following steps:
- Create a study defining its analysis type and options.
- If needed, define parameters of your study. A parameter can be a model dimension, material property, force value, or any other input.
- Define material properties.
- Specify restraints and loads.
- The program automatically creates a mixed mesh when different geometries (solid, shell, structural members etc.) exist in the model.

6. ANALYSIS OF TWO-WHEELER MAIN SHAFT



6.1 3D Model of a main shaft

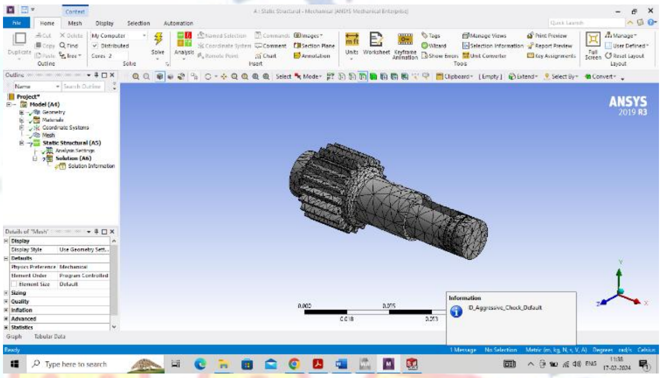


Fig.6.2 meshed file

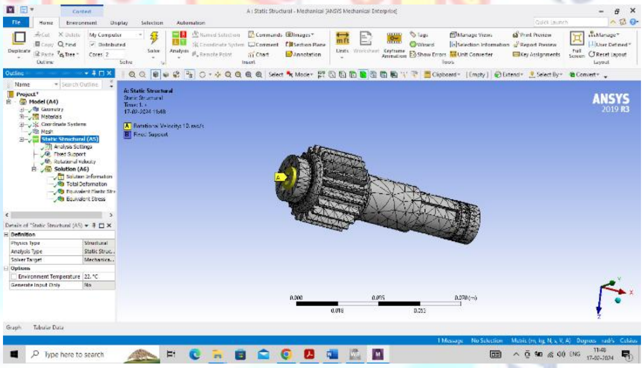


Fig.6.3 Boundary conditions

6.1 Structural steel

Structural Steel	
Density	7850 kg/m³
Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	2e+11 Pa
Poisson's Ratio	0.3
Bulk Modulus	1.6667e+11 Pa
Shear Modulus	7.6923e+10 Pa
Isotropic Secant Coefficient of Thermal Expansion	1.2e-05 1/°C
Compressive Ultimate Strength	0 Pa
Compressive Yield Strength	2.5e+08 Pa

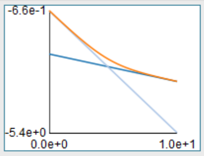
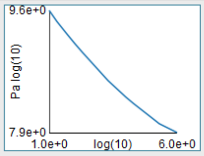
[illegible]	[illegible]
Strain-Life Parameters	
S-N Curve	
Tensile Ultimate Strength	4.6e+08 Pa
Tensile Yield Strength	2.5e+08 Pa

Table 6.1 Material properties of structural steel

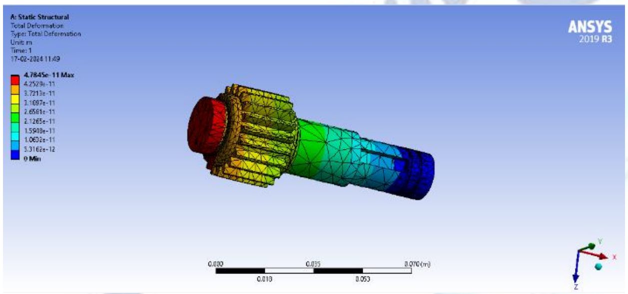


Fig.6.4 Total deformation

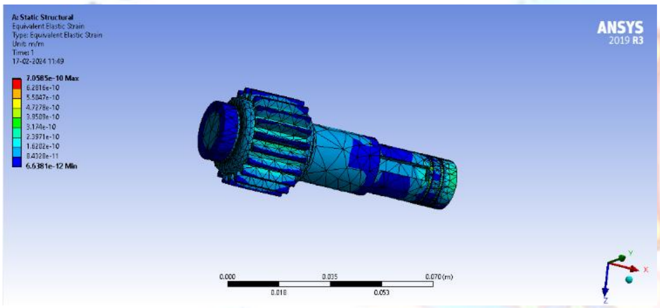


Fig.6.5 Elastic strain

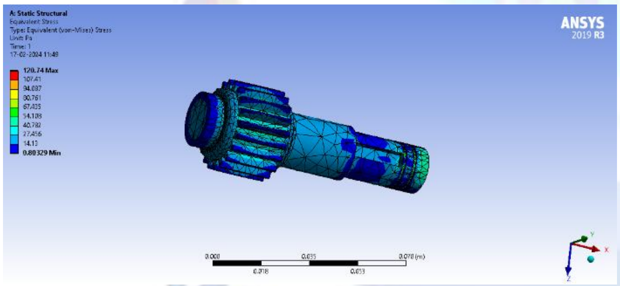


Fig.6.6 Elastic stress

6.2 ALUMINIUM ALLOY

Aluminum Alloy

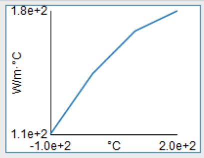
Density	2770 kg/m³
Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	7.1e+10 Pa
Poisson's Ratio	0.33
Bulk Modulus	6.9608e+10 Pa
Shear Modulus	2.6692e+10 Pa
Isotropic Secant Coefficient of Thermal Expansion	2.3e-05 1/°C
Compressive Ultimate Strength	0 Pa
Compressive Yield Strength	2.8e+08 Pa
Thermal	
Isotropic Thermal Conductivity	
Specific Heat Constant Pressure	875 J/kg·°C

Table 6.2 Material properties of Aluminum alloy

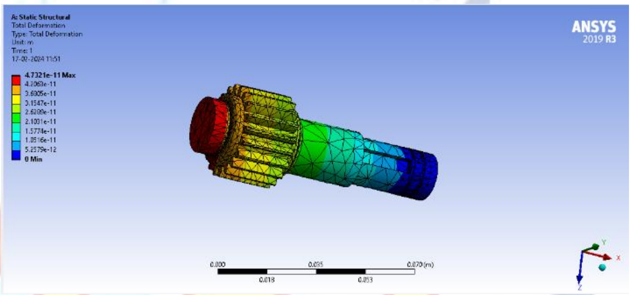


Fig.6.7 total deformation

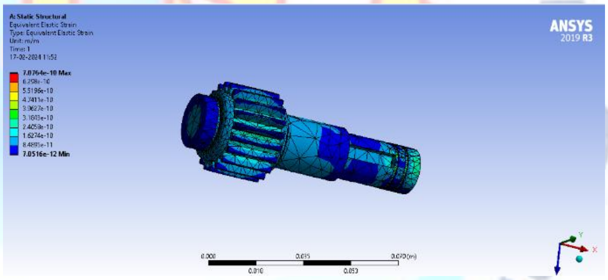


Fig.6.8 Elastic strain

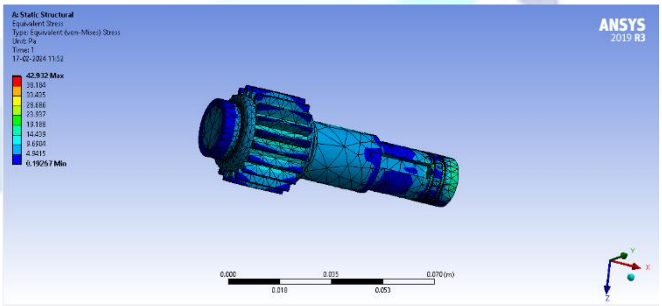


Fig.6.9 Elastic stress

6.3 MAGNESIUM ALLOY

Magnesium Alloy	
Density	1800 kg/m³
Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	4.5e+10 Pa
Poisson's Ratio	0.35
Bulk Modulus	5e+10 Pa
Shear Modulus	1.6667e+10 Pa
Isotropic Secant Coefficient of Thermal Expansion	2.6e-05 1/°C
Compressive Ultimate Strength	0 Pa
Compressive Yield Strength	1.93e+08 Pa
Tensile Ultimate Strength	2.55e+08 Pa
Tensile Yield Strength	1.93e+08 Pa
Thermal	
Isotropic Thermal Conductivity	156 W/m·°C
Specific Heat Constant Pressure	1024 J/kg·°C
Electric	
Isotropic Resistivity	7.7e-07 ohm·m
Magnetic	
Isotropic Relative Permeability	10000

Table 6.3 material properties of magnesium alloy

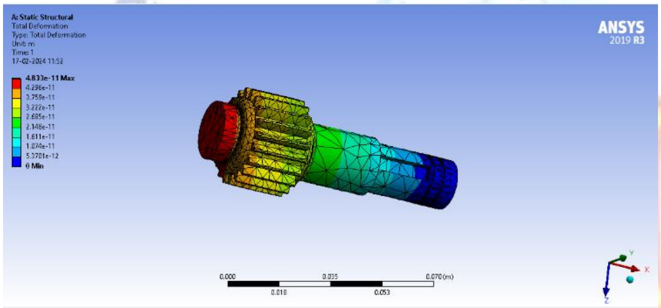


Fig.6.10 Total deformation

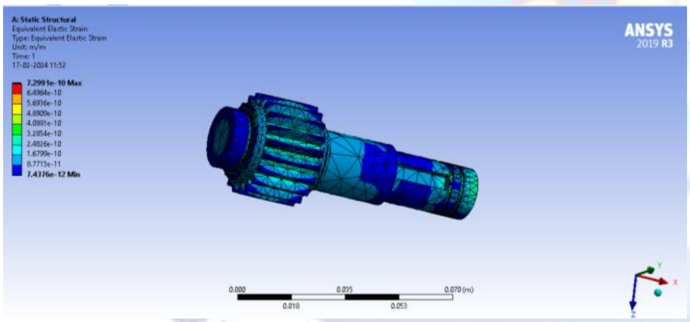


Fig.6.11 Elastic strain

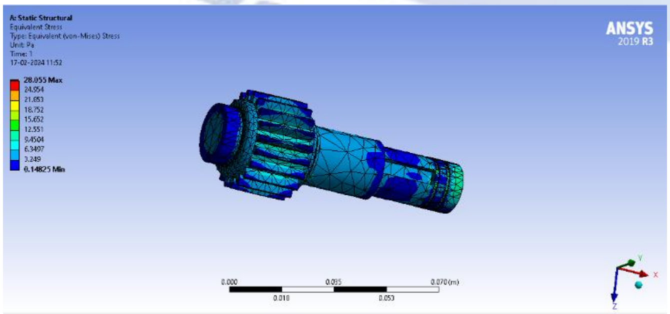


Fig.6.12 Elastic stress

Materials	Total Deformation (m)		Equivalent Elastic Stain		Equivalent Stress (MPa)	
	Min.	Max.	Min.	Max.	Min.	Max
						.
Structural steel	0	4.7845 e-011	6.6381e-012	7.058e-0 10	0.8032 9	120. 74
Aluminum alloy	0	4.7321 e-011	7.0516e-012	7.0764e-010	0.1926 7	42.9 32
Magnesium alloy	0	4.833e-011	7.4376e-012	7.2991e-010	0.1482 5	28.0 55

Table 6.6 Results of all materials

7. CONCLUSION

In conclusion, the main shaft mechanism offers a viable alternative for two-wheeler power transmission, addressing and overcoming the limitations associated with traditional chain drives. The proposed design, coupled with the potential use of composite materials for the shaft, demonstrates the capacity for further innovation and improvement in the field. The results obtained from this study provide valuable insights into the feasibility and efficiency of the main shaft mechanism. These findings serve as a crucial foundation for decision-making in the early stages of development, ultimately saving time and resources. Additionally, the potential for further compactness by reducing the number of bevel gears to two, through a realignment of the engine, highlights the adaptability and versatility of the proposed system. Moreover, the use of aluminum as the material for the main shaft, as determined through ANSYS Workbench simulations, emerges as a favorable choice. The properties of aluminum, including its lightweight nature, high strength, and corrosion resistance, make it an optimal material for enhancing the overall performance and durability of the main shaft mechanism. The ANSYS Workbench analysis substantiates the suitability of aluminum, providing confidence in its application for achieving an optimized design. In essence, the combination of the main shaft mechanism, potential use of composite materials, and the preference for aluminum in ANSYS Workbench simulations collectively contribute to a promising and efficient alternative for two-wheeler power transmission, showcasing the potential for advancements in design and performance within the automotive industry.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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