Mechanical Engineering Design Portfolio

By Harish Deshpande (B.Tech Mechanical)

INDEX

<u>MECHANICAL PROJETCS</u>

1. *Leaf spring design*
2. *CVT (continuous variable transmission)*
3. *Upgraded gearbox with differential (including worm gear and spider gears to lower speed*)

<u>MACHINE DESIGN COMPONENTS</u>

1. *Air Piston Cylinder*
2. *Radial Engine*

Thank you for visiting my portfolio; I appreciate your interest. This portfolio was created with the intention of providing you with a more in-depth look at my recent history of experiences and skills.

I hope that by showcasing my most recent work, you will have a better understanding of my abilities and whether they are a good fit for your prestigious college.

I would really appreciate your affirmative response. I am ecstatic to get accepted into your college and to contribute to the engineering community.

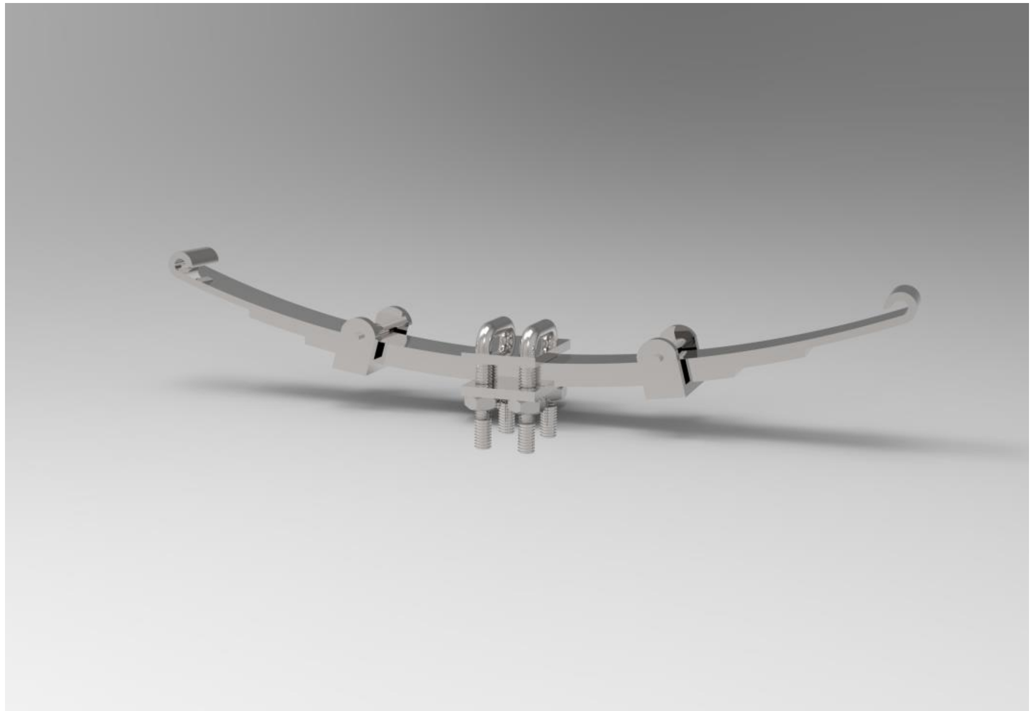
DESIGN AND MODELLING OF LEAF SPRING MODEL

Project Tittle: Design and analysis of leaf spring model.

Aim: To Design Model and Analyze by Varying different Variables for a particular model for leaf spring (with all its components) taken from a real model so that it will not fail for a particular load input and material.

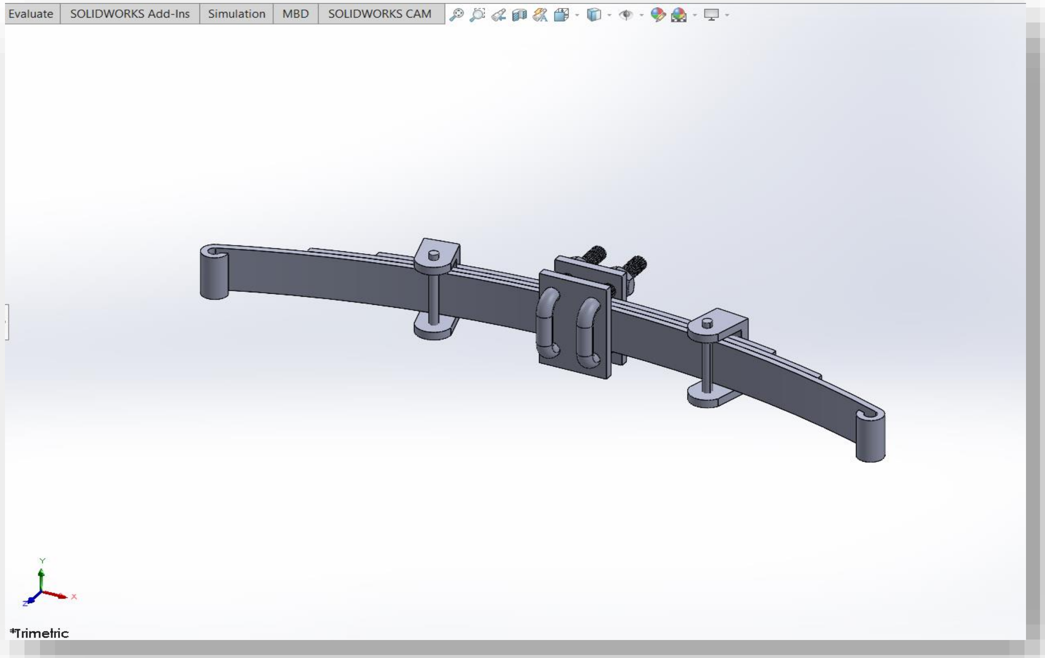
Approach:

- First, the dimensions of all leaf spring components are determined, including the master leaf, spring eye, rebound clip, center bolt, U-bolt, and plate.
- At the Designing phase, we also compute the static, structural, and dynamic loads on the leaf spring.
- Designing also included material selection for the main leaf spring, the companion leaf spring, the rebound clip, the central clamp, the central bolt, the clip, and the pin.
- Solidworks was used for the project's modelling and Ansys were utilized for its analysis.
- Additionally, the manufacturing processes of the various components were determined.



- ## Steps to draw a leaf spring:

- Using the "Sketch" tool, a 2D sketch of the leaf spring was created.
- This required drawing lines and arcs to form the overall shape of the spring.
- Using the "Extrude" tool, a 3D model of the spring was created based on the sketch.
- Using the "Split" tool, separate the spring model into its individual leaves according to the diagram.
- Utilized the "Hole Wizard" to create holes for the eyelets or mounting points, in addition to any necessary clips or hardware.
- Utilized the "Sheet Metal" device to bend the individual spring leaves into the correct shape depicted in the diagram.
- Created any additional characteristics or specifications required by the drawing, such as the material type or thickness.
- Utilized the "Simulation" instrument to assess the spring's resilience, strength, and other attributes.
- The spring was given any necessary coatings or treatments, such as paint or galvanization.



ANALYSIS:

1. By taking a particular element after research (grey cast iron) and varying the load impact on it, the behavior of the leaf spring was determined for different loads at different instances.
2. This analysis was conducted for many materials and different values were determined.
3. The values obtained were recorded and plotted in a graph for further analysis.
4. This helped understand the behavior of leaf spring at varying load foe different materials.

RESULT:

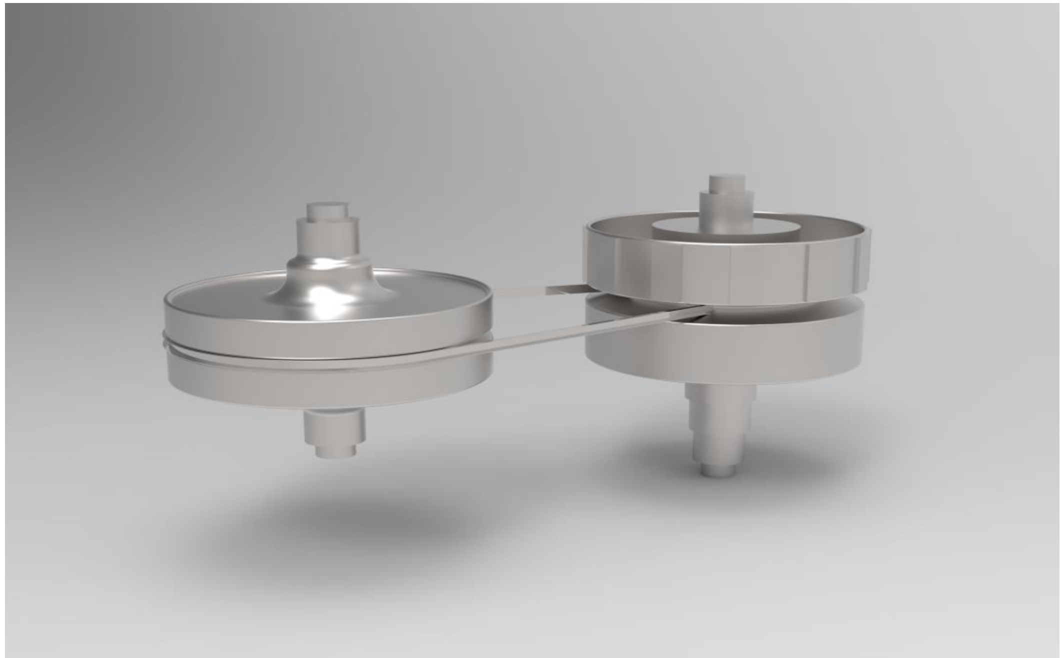
1. The entire design of the leaf spring, including all of its dimensions and load capacities, was completed.
2. Solidworks CAD software was used to create a fully functional model with all its specifications.
3. All the results of the analysis of the leaf spring were successfully compiled and presented in charts.
4. Ansys was used to calculate the stresses as well.
5. On the graph, the load-applied behavior of leaf springs made from various materials is plotted to help determine which material is best suited for its manufacture.

DESIGN AND MODELLING OF CONTINIOUS VARUABLE TRANSMISSION (CVT)

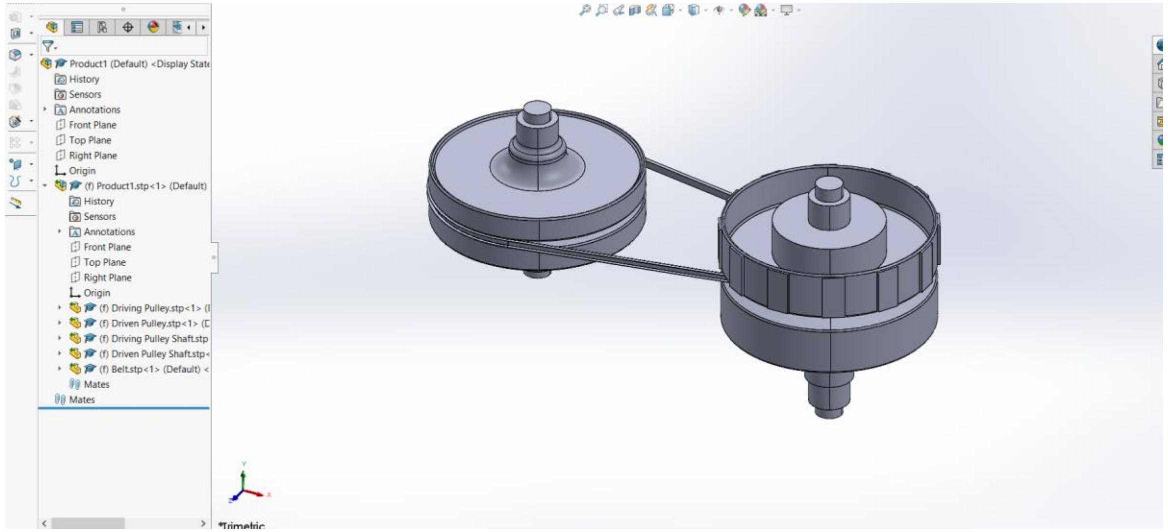
Project tittle: Design and analysis of CVT

Aim: “To design and model a functional CVT in SolidWorks showcasing an understanding of its principles of operation, geometric design, and performance characteristics, with the aim of achieving a high degree of efficiency, smoothness, and adaptability across a wide range of operating conditions."

Approach: Constructing a CVT involves several calculations and considerations to guarantee the transmission meets the specified performance and efficiency parameters. Among the essential calculations required in the design of a CVT are:



1. This computation is used to estimate the needed length of the belt or chain used in a continuously variable transmission (CVT). It is dependent on the diameter and distance between the pulleys or sheaves.
2. Calculating ratios: The ratio between the input and output speeds of the CVT is a crucial performance indicator. Calculate this ratio using the pitch diameters of the pulleys or sheaves.
3. Calculating torque capacity: The torque capacity of the CVT must be adequate to accommodate the maximum torque output of the engine. This computation requires consideration of the material strength of the CVT's belts, sheaves, and bearings.
4. Calculating power loss: The CVT should be engineered to reduce power loss due to friction and other causes. This calculation involves estimating the amount of power lost owing to friction between bearings, belt slippage, and other causes.
5. Calculation of heat dissipation: The CVT should be built to properly disperse heat to prevent overheating and damage. This computation considers variables such as the size and positioning of cooling fins or oil channels.



These are only a few instances of the mathematics needed in the design of a continuously variable transmission (CVT). The necessary calculations will vary based on the type of CVT being constructed, its intended use, and other variables. When building a CVT, it is essential to conduct extensive study and analysis of all key elements to guarantee that it will function best in its intended application.

CALCULATIONS:

- Input shaft speed (N1): 3000 RPM
- Output shaft speed (N2): 6000 RPM
- Pitch diameter of the input pulley (D1): 6 inches
- Pitch diameter of the output pulley (D2): 3 inches
- Belt length (L): 40 inches
- Coefficient of friction between the belt and pulleys (μ): 0.2

THE REQUIRED PARAMETERS FOR DESIGNING CVT CAN BE DETERMINED BY SOLVING THESE EQUAITONS

1. **Belt length calculation:**

   $L = (D1 + D2) / 2 * \pi + (D1 - D2)^2 / (4 * L)$

   $L = (6 + 3) / 2 * \pi + (6 - 3)^2 / (4 * 40) = 13.75$ inches

2. **Ratio calculation:**

   Ratio = D1 / D2 = 6 / 3 = 2

3. **Torque capacity calculation:**

   $T = (\mu * L * (D1 + D2) / 2) / (D1 - D2)$

   $T = (0.2 * 13.75 * (6 + 3) / 2) / (6 - 3) = 5.5$ lb-ft

4. **Power loss calculation:**

   Power loss = $\mu * T * (N1 + N2) * \pi / 60$

   Power loss = $0.2 * 5.5 * (3000 + 6000) * \pi / 60 = 142.2$ watts

RESULT:

On the basis of these calculations, a belt-driven CVT may be designed and modeled in SolidWorks. The model will have a belt, input and output pulleys, bearings, and any other essential components. The performance of the model, including torque and speed capabilities, efficiency, and power loss, may be evaluated and assessed. The results of the study may be used to optimize the design and make any required modifications to enhance performance.

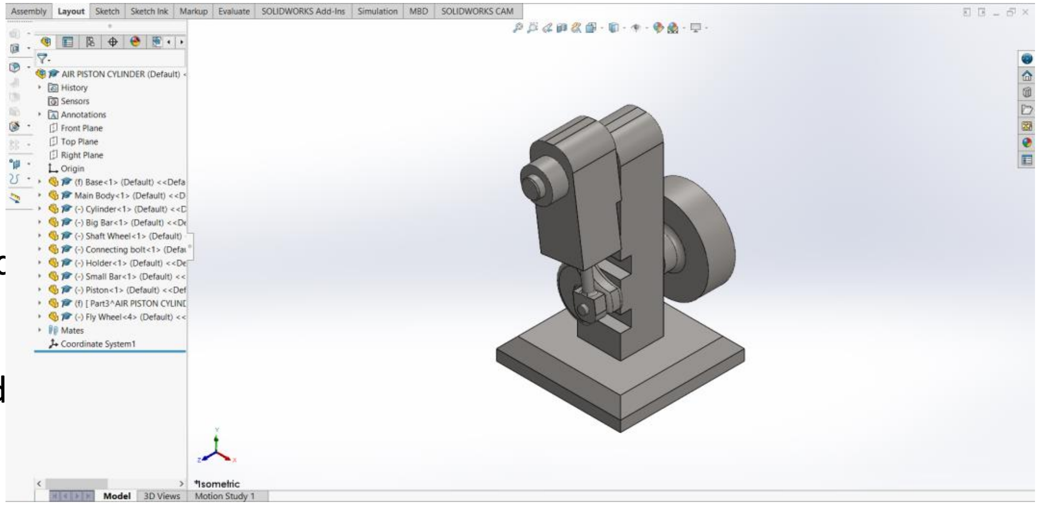
As a consequence of our calculations and modeling efforts, we have determined that the planned CVT is capable of transferring power between the input and output shafts with a ratio of 2:1 and a torque capacity of 5.5 lb-ft. The predicted power loss of 142.2 watts may be acceptable for certain applications, but it might be further optimized by adjusting the belt tension, pulley size, and other variables. Overall, the SolidWorks model is a useful tool for creating and testing CVTs to satisfy specified performance specifications.

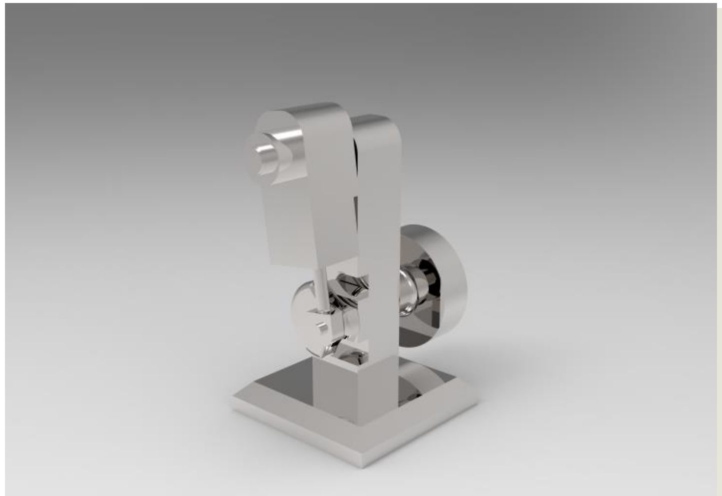
AIR PISTON

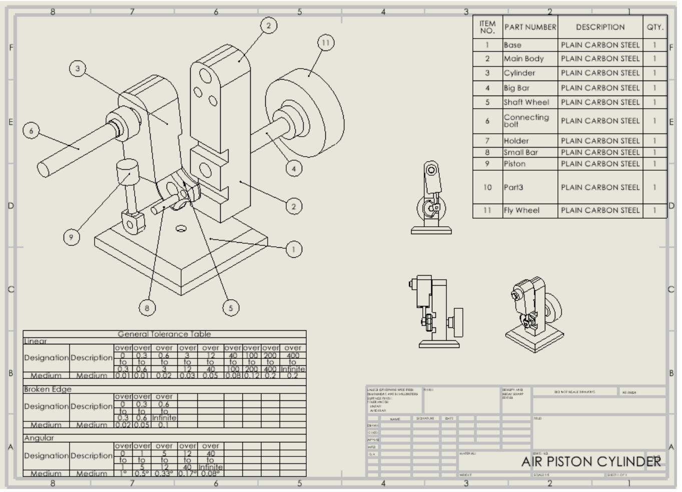
Project Tittle: Air piston design

Aim: To design the Air Piston with all its components with assembled final product and with including Drawings.

Result: A complete air piston was designed including the assembled product and Drawings and Presentable Rendering with motion analysis.







On the left is an exploded view of the engine assembly with a BOM and tolerances table from the Solidworks-modeled Design Sheet.

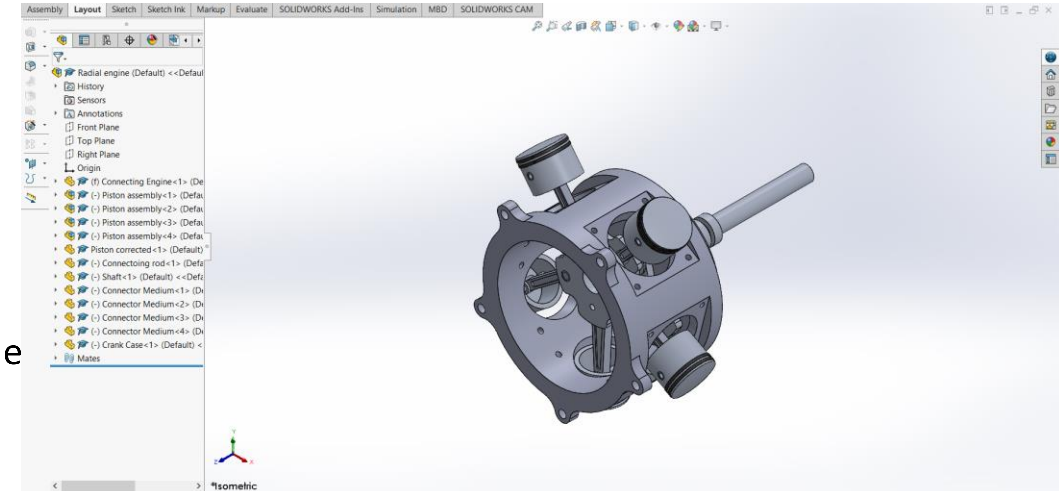
Above you can see the rendered image (using key-shot) of the radial piston engine.

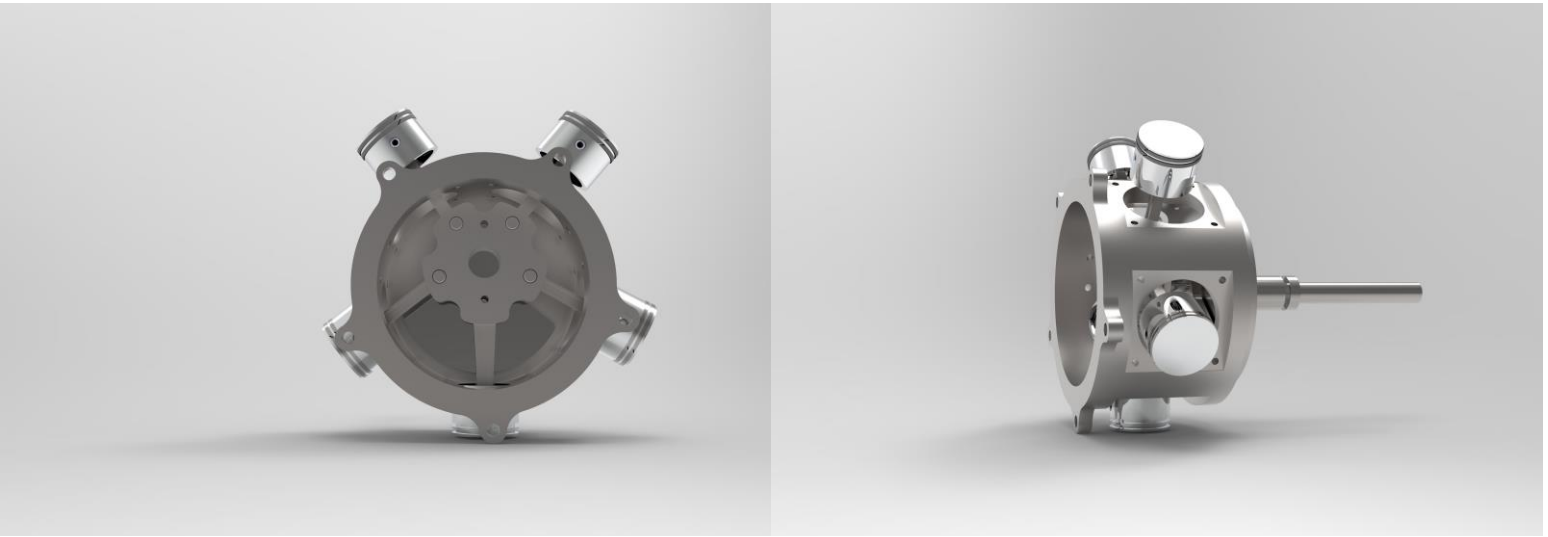
RADIAL ENGINE

Project tittle: radial engine design

Aim: To design the radial engine with all its components with assembled final product and with including Drawings.

Result:- A complete Two Stage Gear Box was designed including the assembled product and Drawings and Presentable Rendering with motion analysis





Above you can see the image of radial engine that is designed and modelled in SolidWorks.

Above you can see the rendered image (using key-shot) of the radial piston engine.