Design and Development of Elliptical Leaf Spring for Vibration Isolation of Engine Mount

Kiran D.Rahane

[1] *Department of Mechanical Engineering, Savitribai Phule Pune University,*
Amrutvahini College of Engineering
sangamner, Pune[MS],India,412411

Proff Nagare P.N

[2] *Department of Mechanical Engineering, Savitribai Phule Pune University,*
Amrutvahini College of Engineering ,
sangamner, Pune[MS],India,412411

ABSTRACT

Agriculture machinery driven by engines generate vibrations that are substantial audible as noise and painful to hand. This reduces efficiency of farmers or farm labor. Hence it is necessary that the vibrations generated by engine be reduced or isolated from the handle or body of application, so that the operator was feel lesser fatigue. Hand-arm vibration (HAV) is transmitted from a work processes into workers' hands. It is caused by operating hand-held tools, hand-guided equipment or by holding materials processed by machines. Multiple studies has shown that regular and frequent exposure to HAV can lead to permanent adverse effects, which are mostly occur when contact with a vibrating tool or work process is a regular and significant part of a person job. Hand-arm vibration cause a range of conditions collectively known as hand-arm vibration syndrome (HAVS) as well as specific diseases such as white finger, carpel tunnel syndrome. It has adverse circulatory and neural effects in the hand. The symptoms include numbness, pain, and blanching (turning pale and ashen).

Keywords: Elliptical Leaf Spring, Vibration, Vibration Isolation, HAV

1. INTRODUCTION

An engine mount is a application component that attaches the engine bracket to the chassis or frame of engine application implement. The engine is connected to the application body by several mounts, which are important for smooth operation of the application. An engine mount should isolate the body from engine-generated noise and vibration. The engine mount must also hold the engine in place and restrict it from moving. Engine vibrations have two major sources: (1) intermittent pulsing due to ignition in the engine cylinders, and (2) inherent unbalances in the reciprocating components of the engine. The frequency of the vibration depends on the number of cylinders, stroke number, and engine speed. Higher frequency range is commonly observed in handheld agriculture machine driven by two stroke petrol engines that run at 5500 rpm and above. These high frequency vibration are major source of discomfort when these machinery such as agriculture sprayers hedge trimmers, routers, grass cutters etc are hand held or shoulder mounted or back held. Significant work has being done in area of vehicle engine vibration damping but not much research is found in these low cost machinery .Hence in our attempt we shall develop an composite half elliptical spring mount and to a comparative study to conventional spring mounts available in market for same application. Different types of engine mounts are used in vehicles. Rubber mounts (or elastomeric mount) are low cost and the simplest type of mounts .

Fig 1: Elliptic Leaf Spring Mounts

2. LITERATURE REVIEW

Mohammed MathenullaSharif, N. SreenivasaBabu, Dr. JaithirthaRao[1]
The aim of this paper is to design and analyze composite mono leaf spring of constant width and thickness having the same bending stiffness of semi-elliptical laminated leaf spring. Stress analysis was done by using analytical method and results obtained by analytical methods are compared with ansys. The results obtained by analytical methods showed good agreement with ansys results.

T. Bhanuprasad, A Purushotham[2]
If number of layers are increased for same thickness the vibrations are less. In this paper we are concluding that using composite S - Glass Epoxy is advantageous. The major disadvantages of composite leaf spring are the matrix material has low chipping resistance when it is subjected to poor road environments which may break some fibers in the lower portion of the spring. This may result in a loss of capability to share flexural stiffness. But this depends on the condition of the road.

Ghodake A.P., Patil K.N[3]

This paper describes design and FEA analysis of composite leaf spring made of glass fibre reinforced polymer. The dimensions of an existing conventional steel leaf spring of a light commercial vehicle are taken for evaluation of results. The 3-D modeling of both steel and composite leaf spring is done and analyzed A comparative study has been made between composite and steel leaf spring with respect to Deflection , strain energy and stresses.

Vijaya Lakshmi, I. Satyanarayana[4]

The objective of this paper is to compare the load carrying capacity, stiffness and weight savings of composite leaf spring with that of steel leaf spring. The design constraints are stresses and deflections. The dimensions of an existing conventional steel leaf spring of a Heavy commercial vehicle are taken Same dimensions of conventional leaf spring are used to fabricate composite multi leaf spring using material unidirectional laminates. Pro/Engineer software is used for modeling and COSMOS is used for analysis. Static & Dynamic analysis of Leaf spring is performed using COSMOS.

Edward Nikhil Karlus, Rakesh L. Himte, Ram Krishna Rathore[5]
The automotive manufacturer tends to enhance soothe of user and achieve appropriate stability of comfort riding virtues and economy. The researchers are very fascinated in the replacement of steel leaf spring by some composite leaf spring because of high strength to weight ratio. On the other hand, there is a restriction for the amount of applied loads in springs. The amplification in applied load creates complexity at geometrical arrangement of vehicle height and erodes other parts of vehicle.

S. Rajesh, G.B. Bhaskar[6]
A three layer parabolic leaf spring of EN45 has been taken for his work. The CAD modeling of parabolic leaf spring has been done in CATIA V5 and analysis was done by ANSYS -11. The finite element analysis (FEA) of the leaf spring was carried out initially discretizing the model into finite number of elements and the nodes by applying the boundary conditions.

R D V Prasad , P.Venkatarao, [7]
Leaf Spring is a critical load bearing element that connects wheel to the chasis in an automobile application. The Suspension leaf spring of one of the potential items for weight reduction in automobiles in order to achieve

increased fuel efficiency and improved ride characteristics. The introduction of fiber reinforced plastics (FRP) made it possible to reduce weight of the product without any reduction in load carrying capacity and stiffness.

M. Raghavedra , Syed Altaf Hussain, K. Palani Kumar[8]
This paper describes design and analysis of laminated composite mono leaf spring. Weight reduction is now the main issue in automobile industries. In the present work, the dimensions of an existing mono steel leaf spring of a Maruti 800 passenger vehicle is taken for modeling and analysis of a laminated composite mono leaf spring with three different composite materials namely, E-glass/Epoxy, S-glass/Epoxy and Carbon/Epoxy subjected to the same load as that of a steel spring.

Spring Mounts – Elliptic Leaf Type (Naval "X" Type)[9]
This type of vibration and shock isolator was designed specifically for shipboard or mobile applications. They are particularly suitable to protect delicate shipboard equipment from shock due to underwater explosions or sudden stoppage of vehicles for vehicle-mounted equipment.

3. VIBRATION ANALYSIS RESULTS

Sr .No	Load (gm)	Speed	Acceleration ($mm/s^{2)}$	Frequency Hz	Amplitude or Displ. (mm)
1	1500	1315	315	415	0.47
2	2000	1275	356	408	0.99
3	2500	1245	372	417	0.93
4	3000	1205	394	426	1.77
5	3500	1185	410	434	1.33
6	4000	1155	427	444	1.55

Table 1: Vibration Analysis Results Of Conventional Rubber Mount

Sr .No	Load (gm)	Speed	Acceleration (mm/s^{2})	Frequency Hz	Amplitude or Displ. (mm)
1	1500	1315	256	367	0.46
2	2000	1275	264	372	0.98
3	2500	1245	276	380	0.92
4	3000	1205	281	376	1.16
5	3500	1185	288	384	1.32
6	4000	1155	291	389	1.54

Table 2 : Vibration Analysis Results Of Elliptical Leaf Spring Without Centroidal Leaf Spring (SS-314)

Sr .No	Load (gm)	Speed	Acceleration (mm/s^2)	Frequency Hz	Amplitude or Displ. (mm)
1	1500	1315	231	330	0.44
2	2000	1275	238	335	0.96
3	2500	1245	249	342	0.90
4	3000	1205	253	339	1.14
5	3500	1185	259	346	1.30
6	4000	1155	262	351	1.52

Table 3 : Vibration Analysis Results Of Elliptical Leaf Spring With Centroidal Leaf Spring (SS314)

Sr .No	Load (gm)	Speed	Acceleration (mm/s^2)	Frequency Hz	Amplitude or Displ. (mm)
1	1500	1315	208	297	0.42
2	2000	1275	215	302	0.94
3	2500	1245	225	308	0.88
4	3000	1205	228	306	1.12
5	3500	1185	234	312	1.28
6	4000	1155	236	316	1.50

Table 4 : Vibration Analysis Results Of Elliptical Leaf Spring Without Centroidal Leaf Spring(EN-48 D)

Sr .No	Load (gm)	Speed	Acceleration (mm/s^2)	Frequency Hz	Amplitude or Displ. (mm)
1	1500	1315	187	268	0.40
2	2000	1275	194	272	0.92
3	2500	1245	201	278	0.86

4	3000	1205	206	276	1.03
5	3500	1185	211	281	1.26
6	4000	1155	213	285	1.48

Table 5 : Vibration Analysis Results Of Elliptical Leaf Spring With Centroidal Leaf Spring (EN-48 D)

4. CONCLUSION

Comparative analysis of the performance of the system with elliptical spring mounts made from EN48D & SS 304 materials .Conclusion will be drawn on the basis of theoretical and experimental results. Vibration results using rubber mount and leaf spring can be done . Comparitive vibrations in leaf spring is less than the vibration mount . Also the spring having the centriodal axis leaf spring having vibration less than without centroidal axis leaf spring .

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