International Journal of Research
Available at https://edupediapublications.org/journals

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017

Design and Analysis of Leaf Spring Using FEA by Using Different Materials

By

Hamid Hussein Ali   Kareem Idan Fadheel   Ahmed Mohamed Aliywy

Hamid80_n88@yahoo.com   kareem.idam@yahoo.com   Ahmed10121981@Yahoo.Com

1-ABSTRACT

The aim of this research is to calculate the deformations and stresses and strain values and the values of safety factor for the leaf spring used in the military jeep design, where the focus was on the analysis provided by the computer using finite element where the analysis for the spring which absorbs vibrations during vehicle movement, which also works as a structure to support the vertical load hanging by the same vehicle and its cargo .under operating conditions behave platelets complex behavior due to loads meted out as was the analysis and prediction of displacement values of stresses and strain . These plates that we are going to analyze a specially designed military jeep car, where bears and reduce the vibrations resulting from military operations. The main objective of this research is to reduce stress and increase strength through a change in the type of metals used. To create this research we used

Cad-tool pro-e / creo-2) and the analysis we used cae tool (Ansys workbench) . On the whole, in most cases the plates used are of steel type in this search looking for another metal type gives the same as what gives steel or better where the use of two types of minerals, namely (monel-400 and en9) and comparing this with the steel to see results. Where were resistant minerals that are best instead of steel in terms of reducing stress and increase resistance.

2-INTRODUCTION

A spring is defined as an elastic body, whose function is to distort when loaded and to recovers its original shape when the load is removed.

Semi- elliptic leaf springs are around universally used for hang in light and heavy mercantile vehicles. For cars also, these are widely used in rear hang. The spring consists of a number of leaves called blades. The blades are varying in length. The blades are us generally given an initial drooping or cambered so that they will tend to straighten under the load. The leaf spring is based upon the theory of a beam of uniform strength. The lengthy blade has eyes on its ends. this blade is called main or central leaf, the remaining blades are called graduated leaves. All the blades are restricted together by means of steel straps. The spring is mounted on the arbor of the vehicle. The entire vehicle remainder on the leaf spring. The front end of the spring is joint to the frame with a simple pin joint, while the rear end of the spring is connected with a fetter. Shackle is the malleable link which join between leaf spring rear eye and frame. When the vehicle comes across a overthrow on the road surface, the wheel moves up, leading to aberration of the spring. This changes the length between the spring eyes. If both the ends are fixed, the spring will not be able to accommodate this change of length. So, to accommodate this variation in length restriction is provided as one end, which gives a flexible connection. [1&2]

Leaf springs are mainly used in suspension systems to absorb shock loads in automobiles like light motor vehicles, heavy duty trucks and in rail systems. . It carries sidelong loads, brake torque, lead torque in addition to impact absorbing [3]. The advantage of leaf spring over helical spring is that the ends of the spring may be guided along a definite path as it deflects to act as a structural member in addition to energy absorbing device [4]. According to the studies made a material with maximum strength and minimum modulus of elasticity in the longitudinal direction is the most suitable material for a leaf spring [5].

3-MATERIALS AND METHODS

In this project we designed one single leaf spring by using cad tool (creo-2) and then analyzing by using cae tool (Ansys workbench) and here we have steel is a existing material and to get more accurate results here we also analyzing our object with 3 different materials and those materials are (en9, monel-400,) and applying 3 boundary conditions (85000N, 9500N, 125000N loads)and calculating its maximum deformation and stress and strain energy and safety factor values for all materials from all these results here can conclude which material can be replace with existing steel material. **[6]**

4. CREO DESIGN PROCESS

To create single leaf spring here we have to create its direction by using sketcher then we should use extrude option to complete object. And the design steps shown in below figure

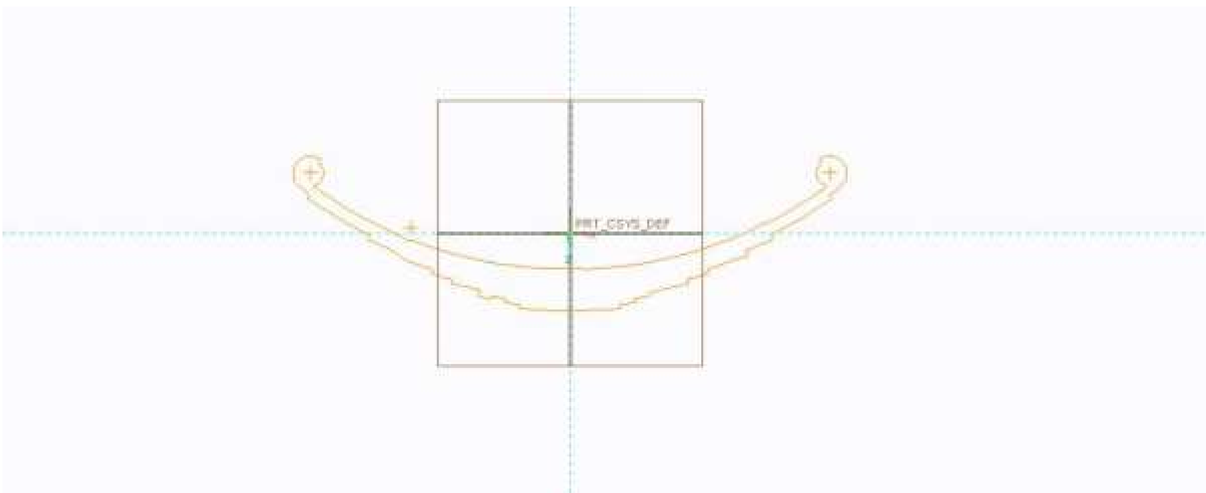


Fig 4.1 leaf spring outer sketcher

The above sketcher shows the complete sketcher of the leaf spring model and the shape has been created by using curves and line only. After completing the sketchers if you want to edit the dimension just double click on it and then you can modify your dimension. After perfecting of total sketch click on ok.

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017

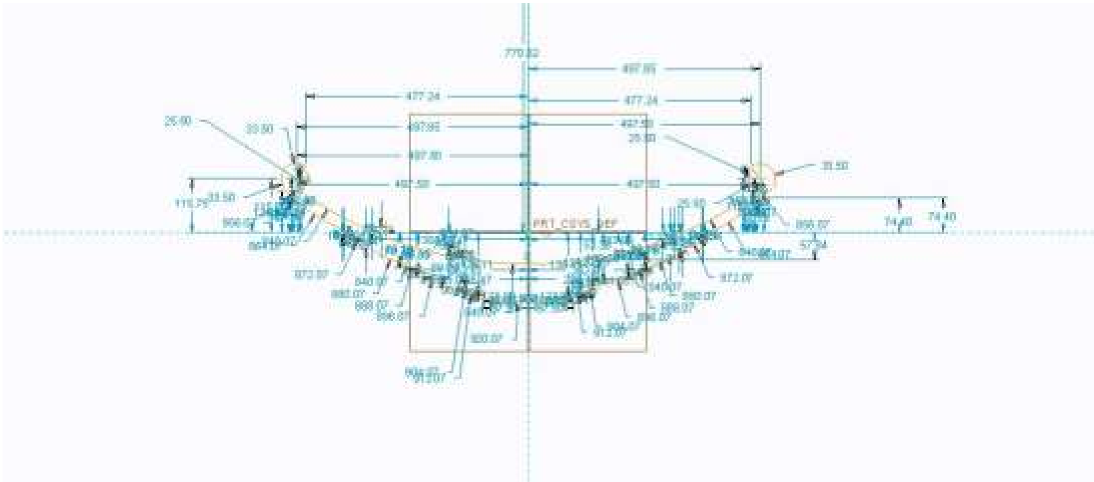


Fig 4.2 leaf spring sketcher with all dimensions

and this sketcher should be close. After **perfecting** of total sketch just click on ok

Fig 4.3 leaf spring complete 3d developed model

The above figure shows that 3d model of leaf spring and after completion it just click ok.

To **importation** into Ansys save file type as IGES/STEP.

5. FINITE ELEMENT ANALYSIS OF LEAF SPRING

Finite element analysis of leaf spring was used for observing the structural results on the object and calculating like deformation and stress and strain values for different materials. To do this here you have to import your object from design software and apply real time boundary conditions.

Here we analyzing our model with (3) different loading conditions (85000N, 95000N, 125000N) and with 3 materials (Steel, En9, Monel-400) in this steel only existing material and reaming all are changing materials.

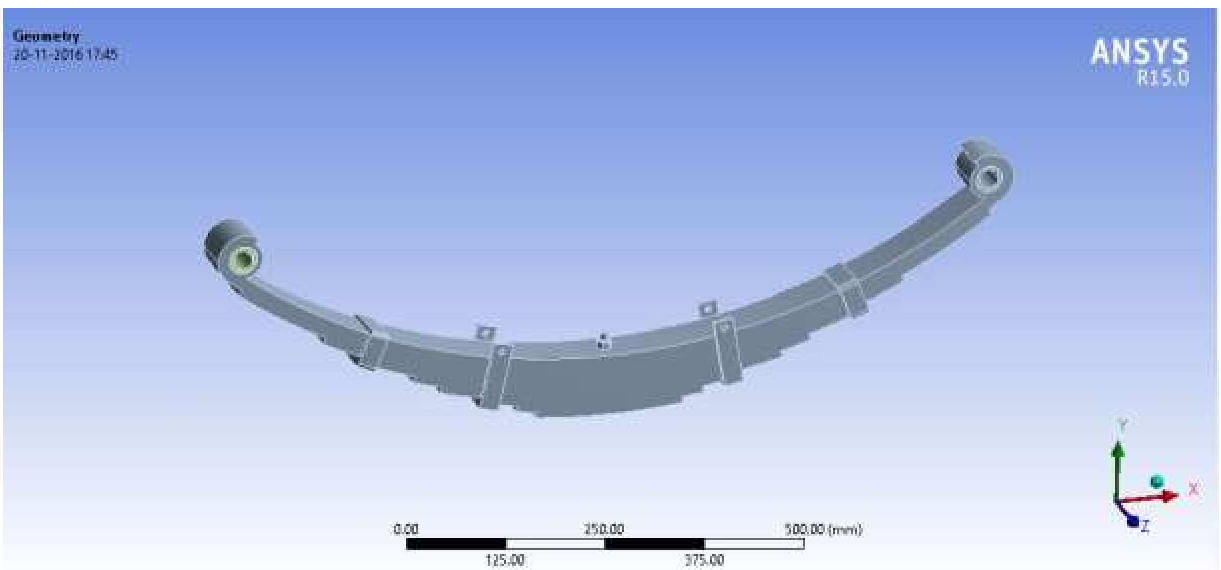


Fig 5.1 imported model from creo-2

5.2 Meshing

The meshing is so significant for the analysis of any tectonic object or body. Meshing is the process of description of a body into minimal segment for accuracy of the results the web or group of nodes and elements is known as mesh. Basically, there are two types of meshing are used one is Quad and another one Trial. In the meshing Quad type is used.

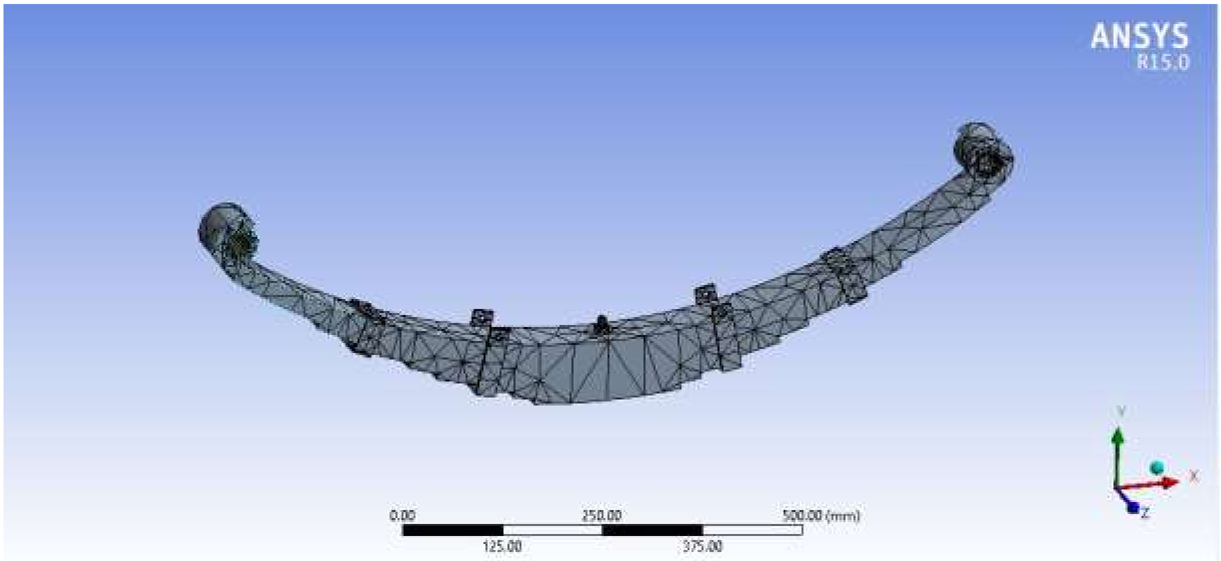


Fig 5.2 meshing

Material Properties

	steel	En9	Monel400
Young's modules(pa)	200e9	210E^9	125E^9
Poison ratio	0.3	0.33	0.32
Density(kg/m^3)	7850	7850	7800
Yield strength (Mpa)	200	350	450

Table 1 (material properties)

5.3 Boundary conditions:

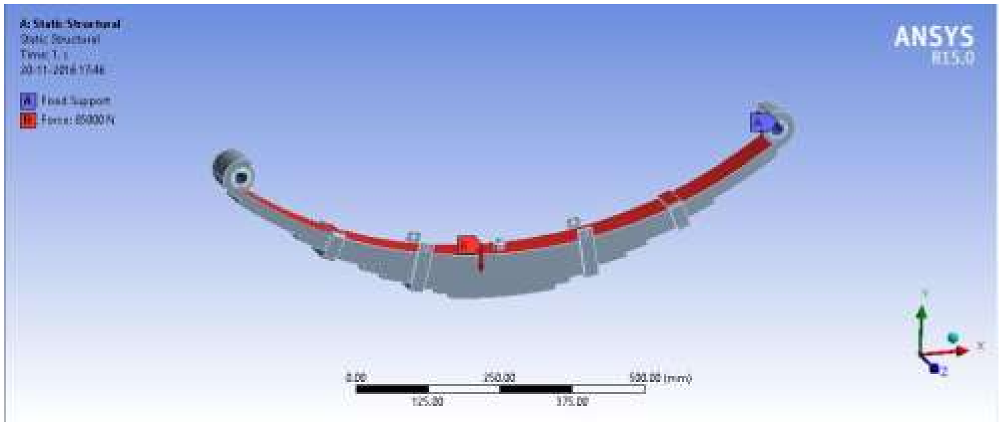


Fig 5.3 boundary condition on leaf spring

The above figure shows that boundary conditions of a leaf spring and here applied 85000N on the object and fixing two ends.

5.4 Results for boundary condition (85000N)

Steel (existing material)

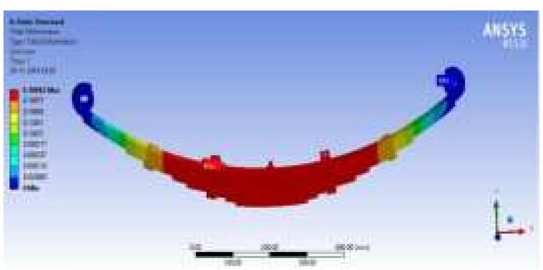


Fig 5.4.1 Steel deformation for 85000N

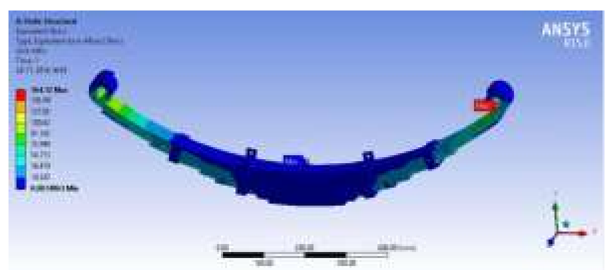


Fig 5.4.2 steel stress for 85000N

Fig 5.4.3 Steel strain energy for 85000N

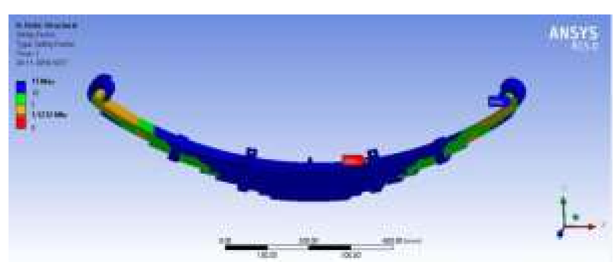


Fig 5.4.4steel safety factor for 8500N

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017

Results for (en-9 material)

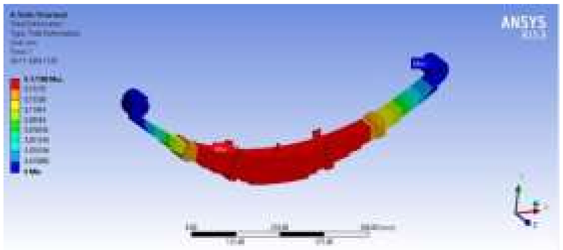


Fig 5.4.5 En- 9 deformation for 85000N

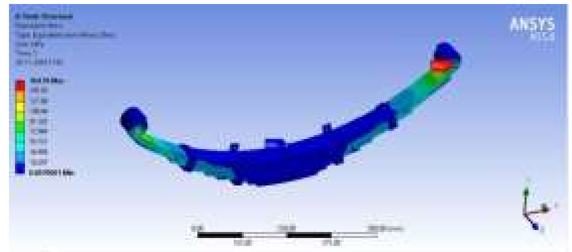


Fig 5.4.6 en-9 stress for 85000N

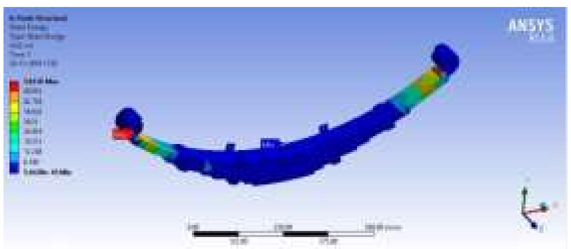


Fig 5.4.7En-9 strain energy for 85000N

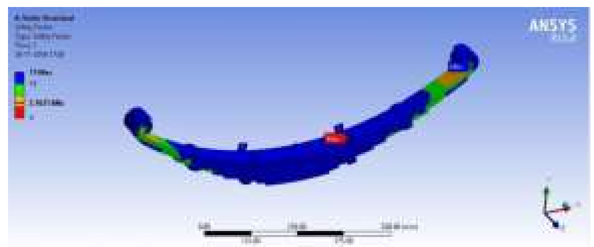


Fig 5.4.8En-9 safety factor for 85000N

RESULTS FOR MONEL 400

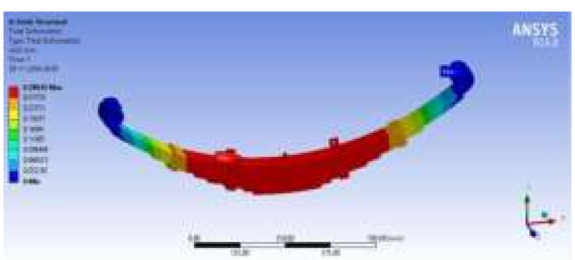


Fig 5.4.9Monel 400 deformation for 85000N

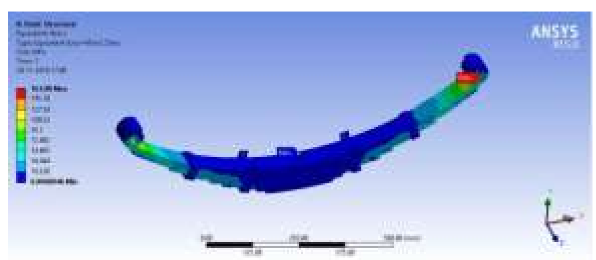
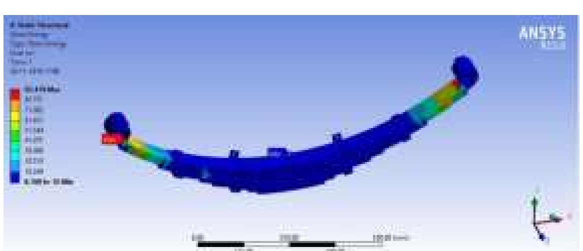


Fig 5.4.10Monel 400 stress for 85000N



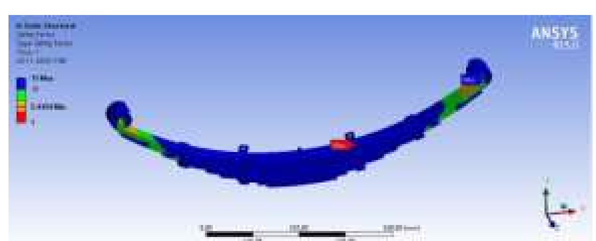


Fig 5.4.11Monel 400 strain energy for 85000N

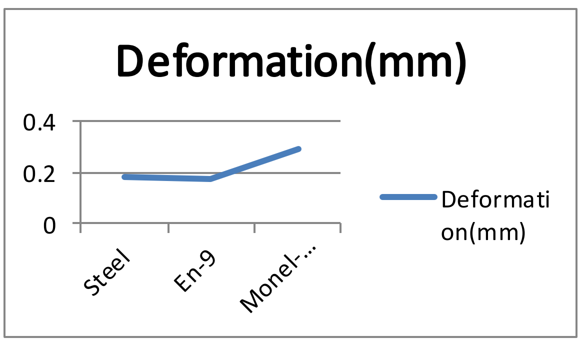
Fig 5.4.12Monel 400 safety factor for 85000N

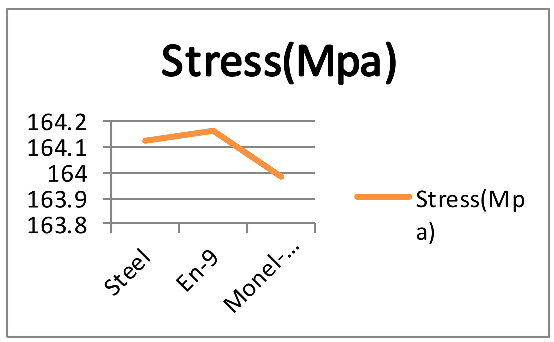
And here increasing its loading from 85000N to 9500N and 125000N and calculating the same results for all materials.

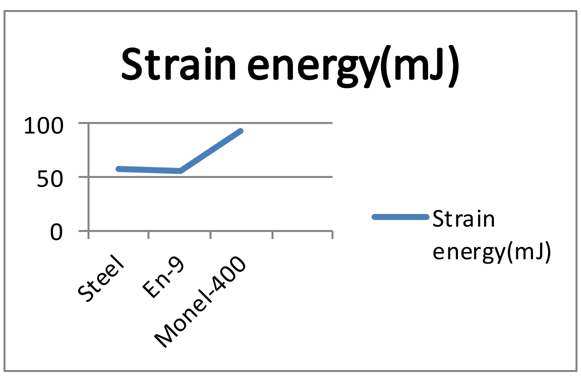
Tables

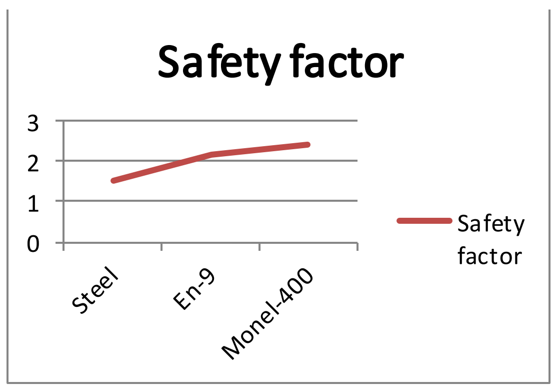
	Deformation(mm)	Stress(Mpa)	Strain energy(mJ)	Safety factor
Steel	0.18062	164.12	57.71	1.5232
En-9	0.17188	164.16	54.936	2.1625
Monel-400	0.28945	163.98	92.419	2.4394

Graphs









International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017

5.5 Results for 95000N

Steel

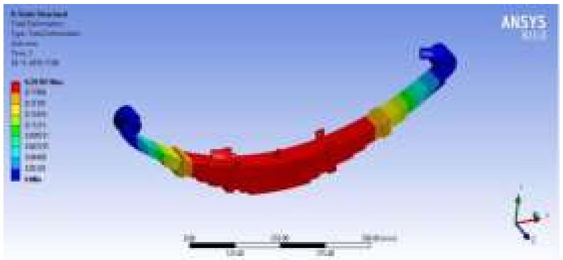


Fig 5.5.1 Steel deformation for 95000N

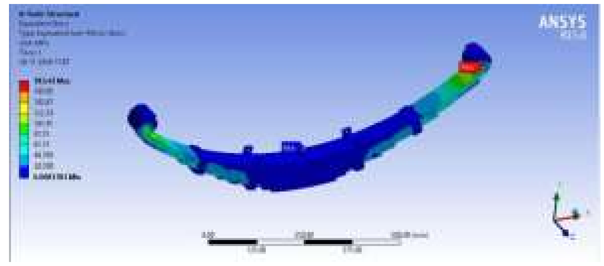


Fig 5.5.2 Steel stress for 95000N

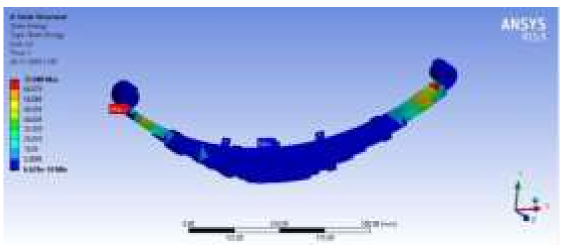


Fig 5.5.3 Steel strain energy for 95000N

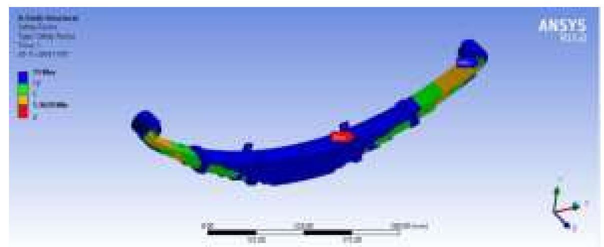


Fig 5.5.4 Steel safety factor for 95000N

En9

Fig 5.5.5 en-9 deformation for 95000N

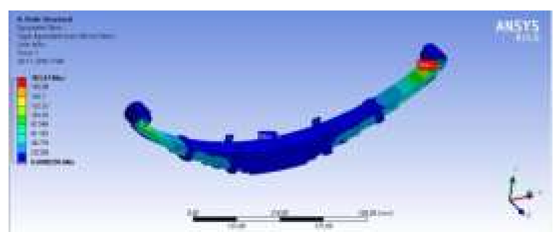


Fig 5.5.6 en-9 stress for 95000N

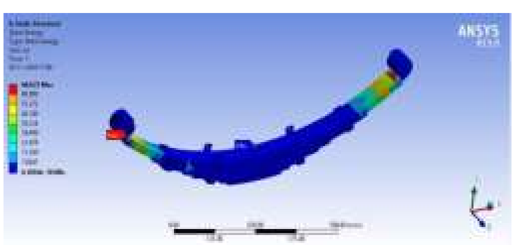


Fig 5.5.7 en-9 strain energy for 95000N

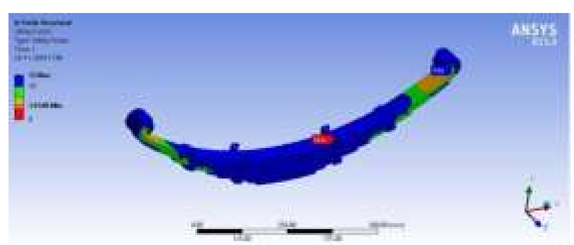


Fig 5.5.8 en-9 safety factor for 95000N

Monel-400

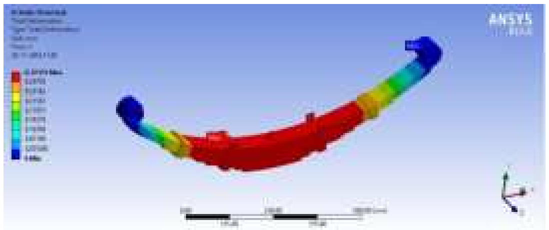


Fig 5.5.9 monel-400 deformation for 95000N

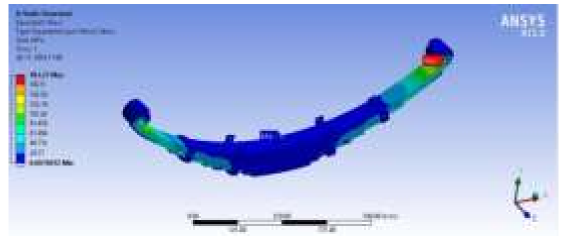


Fig 5.5.10 monel-400 stress for 95000N

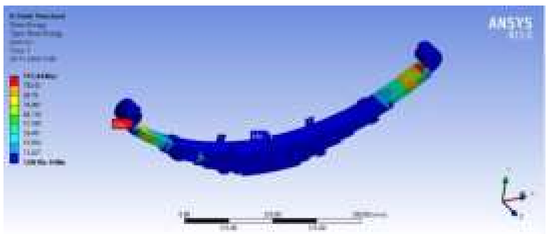


Fig 5.5.11 monel-400 strain energy for 95000N

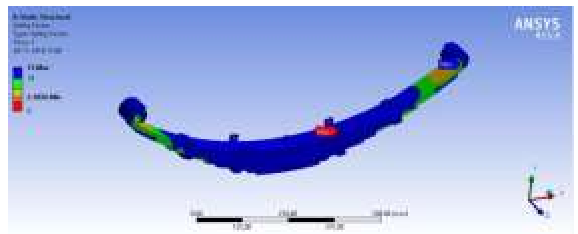


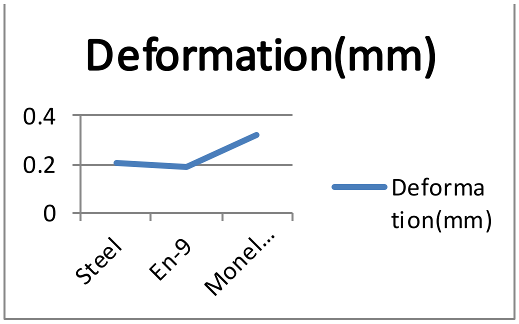
Fig 5.5.12 monel-400 safety factor for 95000N

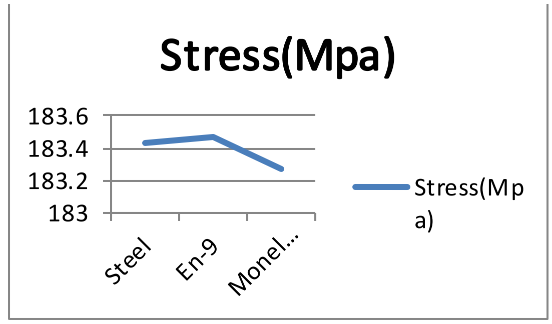
Tables:

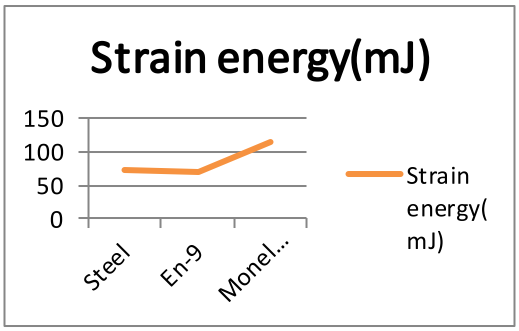
	Deformation(mm)	Stress(Mpa)	Strain energy(mJ)	Safety factor
Steel	0.20187	183.43	72.088	1.3629
En-9	0.1921	183.47	68.622	1.9349
Monel-400	0.32351	183.27	115.44	2.1826

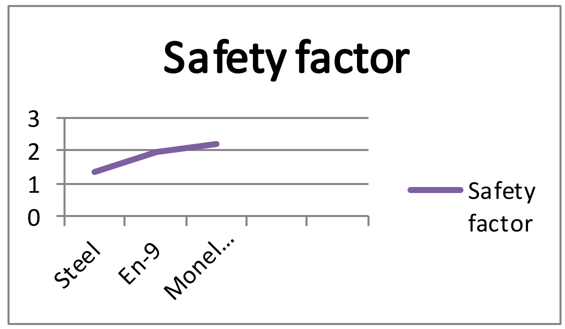
Graphs:

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017









5.6Results for 125000N

Steel

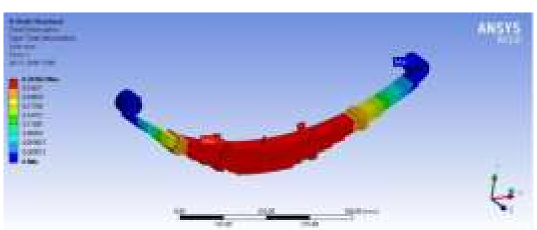


Fig 5.6.1 Steel deformation for 125000N

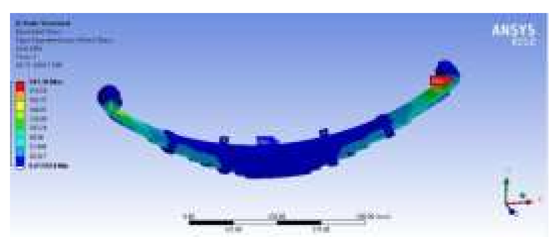
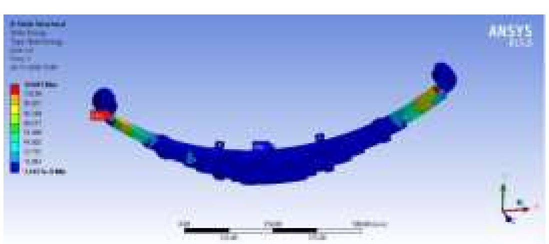


Fig 5.6.2 Steel stress for 125000N



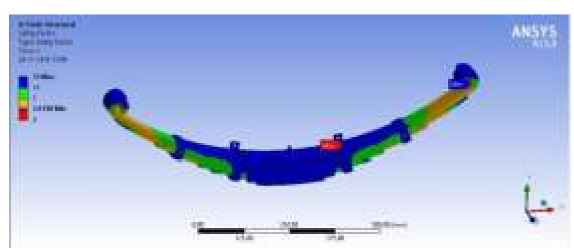


Fig 5.6.3 Steel strain energy for 125000N

Fig 5.6.4 Steel safety factor for 125000N

En-9

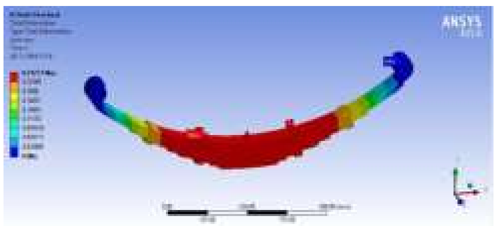


Fig 5.6.5 en-9 deformation for 125000N

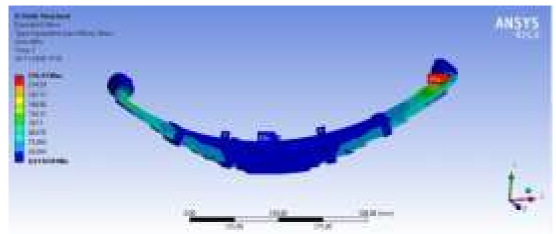


Fig 5.6.6 en-9 stress for 125000N

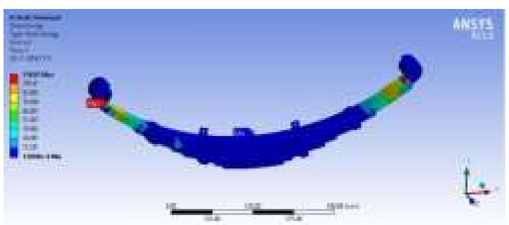


Fig 5.6.7 en-9 strain energy for 125000N

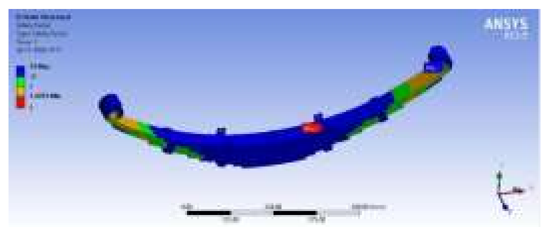


Fig 5.6.8 en-9 safety factor for 125000N

Monel-400

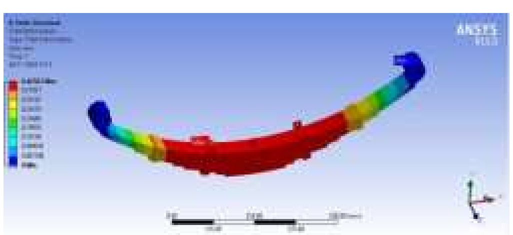


Fig 5.6.9 monel-400 deformation for 125000N

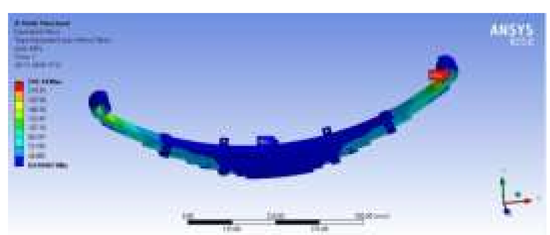
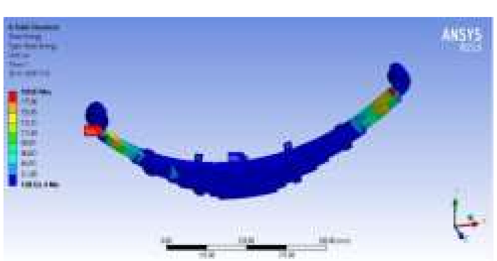


Fig 5.6.10 monel-400 stress for 125000N



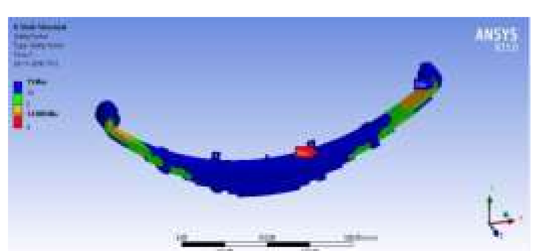
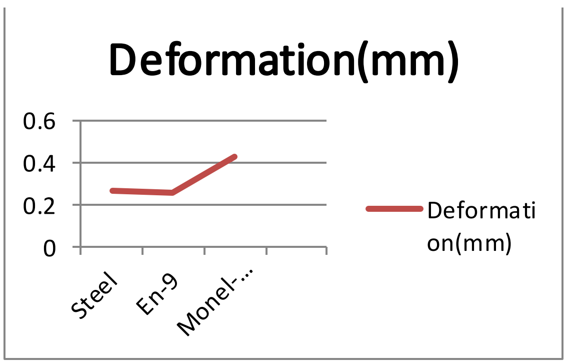


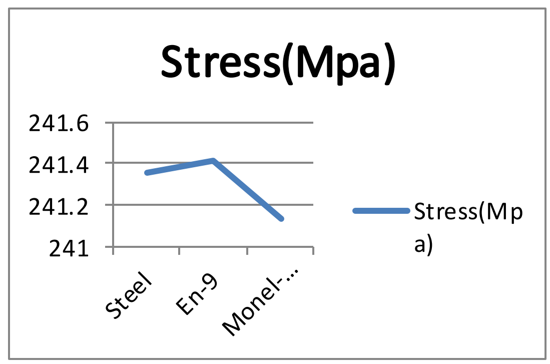
Fig 5.6.11 monel-400 strain energy for 125000N Fig 5.6.9 monel-400 safety factor for 125000N

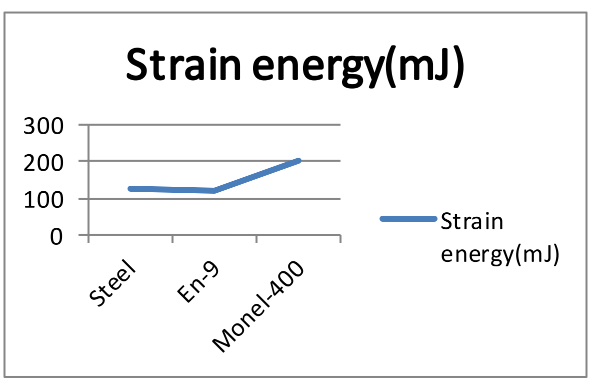
Tables:

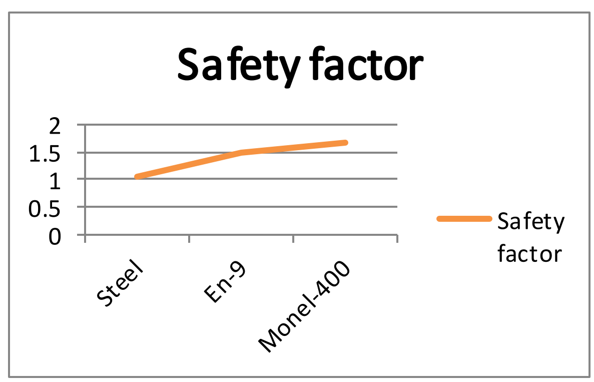
	Deformation(mm)	Stress(Mpa)	Strain energy(mJ)	Safety factor
Steel	0.26562	241.36	124.81	1.0358
En-9	0.25277	241.41	118.81	1.4705
Monel-400	0.42567	241.14	199.87	1.6588

Graphs









p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 07
June 2017

CONCLUSION

1- designed using fiber spring (cad tool (creo-2) and analyzed by ((ANSYS workbench with loads of different conditions and compared with the spring steel fibers, where the difference was clear to **decrease** stress and increase resistance.

2- increase the safety factor and portability high stress compared with steel

3- up resistance loads (125000N) any breakage resistance high compared with steel springs

4-plasticity coefficient is good, making it a useful and valid in the industry

References

1. Rajendran I, Vijayarangan S, Design and Analysis of a Composite Leaf Spring, Journal of Institute of Engineers, India ,vol.-8,2-2002

2.Shishay Amare Gebremeskel, Design, Simulation, and Prototyping of Single Composite Leaf Spring for Light Weight Vehicle, Global Journals Inc. (USA) 2249-4596, Volume 12 Issue 7, 21-30, 2012

3. M.Venkateshan , D.Helmen Devraj, "design and analysis of leaf spring in light vehicles", IJMER 2249-6645 Vol.2, Issue.1,pp.213-218, Jan-Feb 2012.

4. R.S.Khurmi and J.K.Gupta Machine Design chapter 23.

5. U. S. Ramakant & K. Sowjanya, "Design and analysis of automotive multi leaf springs using composite material", IJMPERD 2249-6890 Vol. 3, Issue 1,pp.155-162, March 2013,

6.U. S. Ramakant & K. Sowjanya, "Design and analysis of automotive multi leaf springs using composite material", IJMPERD 2249-6890 Vol. 3, Issue 1,pp.155-162, March 2013,