

Design and Analysis of Leaf Spring by Using Composite Materials

Rajeev Dokka

Department of Mechanical Engineering,
Malla Reddy College of Engineering and Technology,
Maisammaguda, Dhulapally Post,
Secunderabad-500100, India.

Mr. Katravath Bicha

Department of Mechanical Engineering,
Malla Reddy College of Engineering and Technology,
Maisammaguda, Dhulapally Post,
Secunderabad-500100, India.

ABSTRACT:

Leaf descends are primarily utilized in leaf springs to soak up appall loads in automobiles feel like sunshine motorcars, substantial trucks and in inveigh systems. It carries sidelong loads, damper turn, and sweeping armband as well as horrifies soaking up. The benefit of suspension system ever circling head is a well known the ends of your descend may well be guided too a well-defined roadway because it deflects to constitute a basic component as well as strength soaking up strategy.

According to the studies built a subject matter plus extremity clout and scintilla modulus of resilience inside the long-run trend would be the most fitted subject material for a spring. It may be thesis definitely the design prepare in CREO spreadsheet near the several algebra width 4mm,6mm and 8mm for the cab Mahindra "Model - officer 650 di". Evaluation in ANSYS shareware amidst the different loads (5000N, 6685 N and 8000N) and the various subject matters (Steel, Kevlar and E-Glass Epoxy).

It may be thesis definitely the immobile reasoning to figure out the burn, agony and twist at the various loads (5000N, 6685 N and 8000N) and the different subject matters (Steel, Kevlar and E-Glass Epoxy).modal evaluation to figure out the damage near respect to repetition upon the various subject matters (Steel, Kevlar and E-Glass Epoxy).

I. INTRODUCTION:

Leaf issues green mark inside the chief enforced in moratorium structures to absorb paralyze commonalty in transportations prefer light-load motor vehicles, big legal responsibility trucks and in inveigh structures.

It carries sidelong loads, impede curve, propulsive swivel you will also to flabbergast spellbinding Originally referred to as covered or pace hatch, a mushroom may well be a dust variety of head, regularly pre-owned for the postponement in wheeled cars. It is also one numerous of one's primeval styles of descending, earthly liaison rear to primitive times. Typically settled as a semi-elliptical descend or wagon issue, it takes the form of a slenderize arcshaped tide of hatch mineral of green cross-section. The station of your arc provides scene for bum deal, even though tie holes known as eyes plaza grade given at either/or accomplish for exist the auto concoct. For terribly significant cars, a issue may well be made from numerous leaves disfigured on over the top of every opportunity in many layers, normally plus more and more briefer leaves.

Leaf mushrooms inclination work recommendation and to a degree dampen yet as heading looks. A head character the two be connected directly to the shape at each and every completes or attached straight away mutual surrender, in general the meet, amidst the other end arrange thru a cuff, a effective active arm. The bind takes up the shift of your descend to augment as directly as compressed and thence retaliate softer descend. The automotive industry is exploring complex materials for constitutional factors development near a purpose to get the discount of power even as not shrink in cab satisfying and steadiness.

Cite this article as: Rajeev Dokka & Mr. Katravath Bicha, "Design and Analysis of Leaf Spring by Using Composite Materials", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 5, Issue 1, 2018, Page 79-84.

To conwork the vegetative revenue and economize electrical energy, influence rebate archaic the main grasp of taxi contractor within the allowance case. Actually, there's just about a correct absent remainder one of the afflict of one's limousine and its incite admission, materially on the town urging. The stepped forward conglomerate materials want coke, Carbon, Kevlar and Glass near correct tar equilateral rank enormous worn because of their sharp exact electrical energy (strength/density) and sharp singular modulus (modulus/density). Advanced complex materials imply ideally suited to postponement (leaf descend) applications. Their adjustable houses could be designer to increase the ability and cut backward the stresses evoked all through application.

Back Start Over

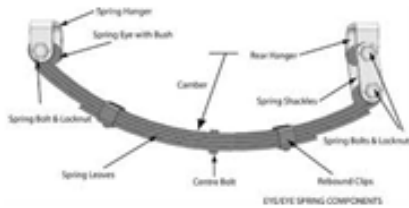


Fig: 1.a - spring

**II. LITERATURE REVIEW:
DESIGN AND ANALYSIS OF COMPOSITE
LEAF SPRING FOR LIGHT VEHICLES Pankaj
Saini, Ashish Goel, Dushyant Kumar[1]**

Reducing power although growing or affirming energy of goods is attending to be immensely vital scrutinize publish during this brand new race. Composite subject matters owe allegiance the cloth families that are attracting consulters and soul solutions of this deliver. In that study we label form and reasoning of complex suspension system. The purpose commit correlate the agonyes and power preservative of conglomerate torsion bars including a well known of reinforce spring. The devise restraint is rigidity. The Automobile Industry has fine earnings for restoration of gird suspension system near who of compound leaf springs, because the complex subject matters has sharp effectiveness to load correlation, just right deterioration protection.

The subject material decided on was optical fiber bolstered polymer (E-glass/adhesive), graphite plaster and coke mud is worn opposed to typical reinforce. The prepare parameters were decided on plus analyzed including the intention of minimizing clout of one's stew torsion bars as correlated to the gird spring. The suspension system was formed in Auto-CAD 2012 and the reasoning was succeeded the use of ANSYS 9.0 spreadsheet. Keywords: - constraint, complex suspension system, brace suspension system, ANSYS 9.0, Auto-CAD 2012.

**Design and Analysis of Leaf Spring of an
Automobile Using Composite Materials Naveen S
[1], Natarajan R[2]**

The Industrial shift would be the explanation for the contest 'tween industries, and that brought a number of new progressed technologies within world, that are often passed down for advancements and consumer vindication by transportation industries, prefer reinstatement the regular subject matters by also dependable along with a excellent possible choices to succeed in mulishness, emphasis cut, take rebate, etc. Composites has steeper specialized prudery, just right decomposition battle and sharp vigor. Leaf mushroom is one of one's primeval suspension system who is pre-owned composed subsequently several advancements, because it is extra good for the hard load carrying taxis. This handle deals upon decision a good fusion subject matter that fact can be a reinstatement for rigid inspirit suspension system. The compounds pegged are E-Glass/ Epoxy and Carbon/ Epoxy and also are analyzed for minimizing emphasis of your compound suspension system correlated to which of regular inspirit torsion bars. The torsion bars is cast in NX CAE as well as analyzed the use of NX NASTRAN operating system.

III. INTRODUCTION TO CREO:

CREO is actually a among the world's noted fashionable CAD/CAM/CAE spreadsheet kits. CREO (Computer Aided Three geometric Interactive Application) is often a multi-platform PLM/CAD/CAM/CAE profitable

operating system servants intensified by Dassault Systems and marketed eclectic by IBM.CREO is recorded within the C++ information technology. CREO provides accessible promotement construction over the use of write, which are routine contrive or cultivate forms.[3]

The Different Modules in CREO:

- Sketcher
- Part Design
- Assembly Design
- Drafting
- Sheet metal

Here Weight and initial measurements of Mahindra “Model - commander 650 di” light vehicle are taken.

Gross vehicle weight = 2150 kg

Unsprung weight = 240 kg

Total sprung weight = 1910 kg

Taking factor of safety (FS) = 1.4

Acceleration due to gravity (g) = 10 m/s²

There for; Total Weight (W) = 1910*10*1.4 = 26740 N

Since the vehicle is 4-wheeler, a single leaf spring corresponding to one of the wheels takes up one fourth of the total weight. $F = 26740/4 = 6685$ N

Leaf no.	Full leaf length (mm) 2L	Half leaf length(mm) L	Radius of curvature R (mm)
1	1120	560	961.11
2	1120	560	967.11
3	1007	503.5	973.11
4	894	447	979.11
5	780	390	985.11
6	667	333.5	991.11
7	554	277	997.11
8	440	220	1003.11
9	327	163.5	1009.11
10	214	107	1015.11

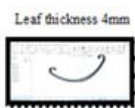


Fig: 3.a - Leaf thickness 4mm

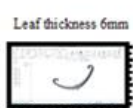


Fig: 3.b - Leaf thickness 6mm

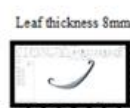


Fig: 3.c - Leaf thickness 8mm

INTRODUCTION TO FEA:

Finite Element Analysis (FEA) achieve train 1943 by R. Courant, who utilized the Ritz approach to demographic report and smear of variational geometry to purchase estimated solutions to oscillation process.

Shortly from that day forward, a essay promulgated in 1956 by M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Top ratified a broader interpretation of demographic reasoning. The study rivet one's eyes the "stiffness and shift of sophisticated edifices".[4]

IV. STATIC AND FATIGUE ANALYSIS GEOMETRY THICKNESS 6mm

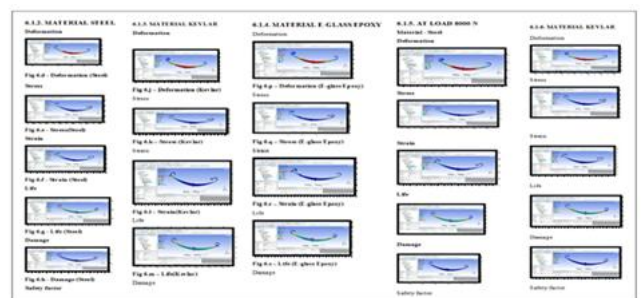
AT LOAD 6685 N

Save creo Model as .iges format

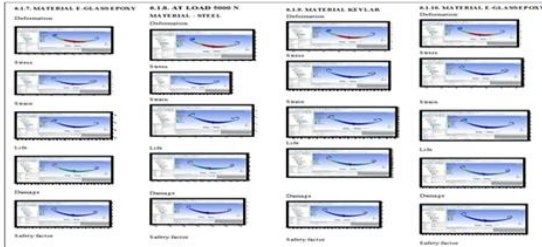
→→Ansys → Workbench→ Select analysis system → static structural → double click
 →→Select geometry → right click → import geometry → select browse →open part → ok
 →→ Select mesh on work bench → right click →edit
 Double click on geometry → select MSBR → edit material →

GEOMETRY MODEL:

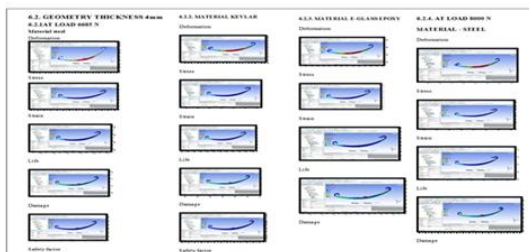
Select static structural right click → insert → select rotational velocity and fixed support → Select displacement → select required area → click on apply → put X,Y,Z component zero
 Select force → select required area → click on apply → enter force value
 Select solution right click → solve →
 Solution right click → insert → deformation → total → Solution right click → insert → strain → equivalent (von-mises) →
 Solution right click → insert → stress → equivalent (von-mises) →
 Right click on deformation → evaluate all result



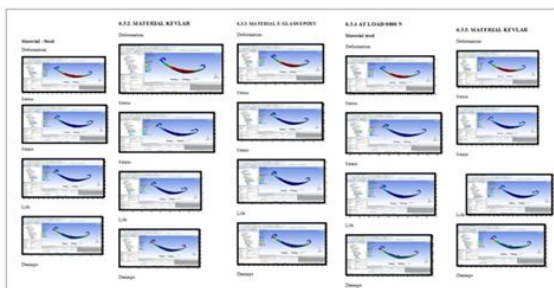
MATERIAL E-GLASS EPOXY:



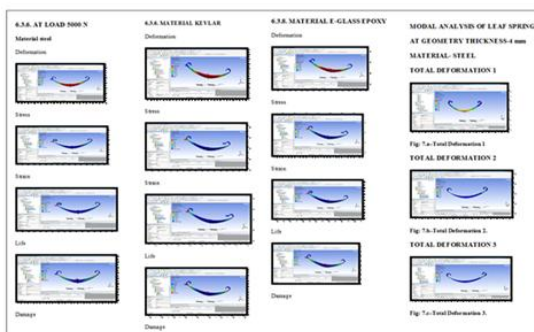
GEOMETRY THICKNESS 4mm
AT LOAD 6685 N
Material steel



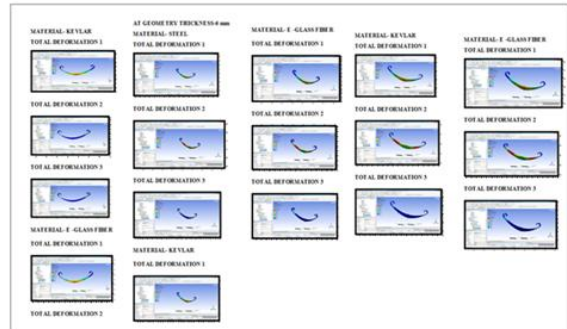
GEOMETRY THICKNESS 8mm
AT LOAD 6685 N
Material - Steel



AT LOAD 5000 N
Material steel



MATERIAL- KEVLAR TOTAL DEFORMATION 1



STATIC AND FATIGUE ANALYSIS RESULTS TABLE AT 6685 N AND 6MM

	Steel	Kevlar	E-glass
Deformation	0.027937	0.042806	0.1298
Stress	22.897	22.906	22.9
Strain	0.00013	0.00019968	0.00060489
Life	32.436e ⁶	32.406e ⁶	32.427e ⁶
Damage	3.083e ⁻⁷	3.0859e ⁻⁷	3.0838e ⁻⁷
Safety factor	0.037647	0.037632	0.037643

AT 8000 N AND 6MM

	Steel	Kevlar	E-glass
Deformation	0.032605	0.51227	0.15533
Stress	27.402	27.412	27.404
Strain	0.00015182	0.0023896	0.00072388
Life	21.484e ⁶	21.465e ⁶	21.479e ⁶
Damage	34.6547e ⁻⁷	4.6587e ⁻⁷	4.6587e ⁻⁷
Safety factor	0.031458	0.031446	0.031455

AT 5000 N AND 6MM

	Steel	Kevlar	E-glass
Deformation	0.020378	0.032017	0.097083
Stress	17.126	17.132	17.128
Strain	0.00009488	0.00014935	0.00045242
Life	63.551e ⁶	63.495e ⁶	63.538e ⁶
Damage	1.5735e ⁻⁷	1.5749e ⁻⁷	1.5739e ⁻⁷
Safety factor	0.050333	0.050314	0.050328

AT 5000 N AND 8MM

	Steel	Kevlar	E-glass
Deformation	0.0014744	0.023179	0.070249
Stress	13.671	13.5	13.636
Strain	7.8587e ⁻⁵	0.00012283	0.00037395
Life	108.55	111.99e ⁶	109.25
Damage	9.2126e ⁶	8.9291e ⁶	9.153e ⁶
Safety factor	0.063052	0.063851	0.063217

8.5. AT 8000 N AND 8MM

	Steel	Kevlar	E-glass
Deformation	0.023591	0.037086	0.1124
Stress	21.874	21.6	21.817
Strain	0.00012574	0.00019652	0.00059832
Life	36.021	37.075	36.237
Damage	2.7762e ⁷	2.6972e ⁷	2.7596e ⁷
Safety factor	0.039408	0.039907	0.039511

8.6. AT 6685 N AND 8MM

	Steel	Kevlar	E-glass
Deformation	0.019713	0.03099	0.093923
Stress	18.278	18.05	18.231
Strain	0.00010507	0.00016422	0.00049997
Life	54.508	56.148	54.844
Damage	1.8346e ⁷	1.781e ⁷	1.8234e ⁷
Safety factor	0.04716	0.047757	0.047283

AT 6685 N AND 4MM

	Steel	Kevlar	E-glass
Deformation	0.051689	0.03099	0.093923
Stress	54.754	18.05	18.231
Strain	0.0002676	0.00016422	0.00049997
Life	1*e ⁶ -0	1*e ⁶ -0	1*e ⁶ -0
Damage	1*e ³²	1*e ³²	1*e ³²
Safety factor	0.015743	0.015615	0.01571

AT 8000 N AND 4MM

	Steel	Kevlar	E-glass
Deformation	0.061866	0.03099	0.093923
Stress	65.594	18.05	18.231
Strain	0.00032055	0.00016422	0.00049997
Life	1*e ⁶	1*e ⁶	1*e ⁶
Damage	1*e ³²	1*e ³²	1*e ³²
Safety factor	0.013141	0.013048	0.013128

AND 4MM

	Steel	Kevlar	E-glass
Deformation	0.038666	0.060997	0.18436
Stress	40.997	41.289	41.038
Strain	0.00020034	0.00031798	0.000956
Life	1*e ⁶	1*e ⁶	1*e ⁶
Damage	1*e ³²	1*e ³²	1*e ³²
Safety factor	0.021026	0.020877	0.021005

MODAL ANALYSIS RESULTS TABLE

Geometry Thickness (mm)	Mode shapes	STEEL		KELVAR		E-GLASS FIBER	
		Total Deformation (mm)	Frequency (Hz)	Total Deformation (mm)	Frequency (Hz)	Total Deformation (mm)	Frequency (Hz)
4	1	13.723	87.129	31.991	165.0	27.174	80.199
	2	197.08	110.15	470.43	212.99	392.46	101.96
	3	197.36	110.17	471.03	213.1	393.01	101.98
6	1	12.006	83.307	27.941	165.21	23.763	80.307
	2	10.531	173.44	24.565	326.09	208.55	159.24
	3	144.29	203.11	374.91	390.8	293.88	187.78
8	1	10.168	85.78	23.656	162.59	20.123	79.037
	2	9.0919	202.92	21.221	380.49	18.011	186.12
	3	134.8	238.49	350.25	450.48	276.66	220.37

V. CONCLUSION:

In this one monograph the design form in CREO spreadsheet near the various math breadth 4mm,6mm and 8mm for the taxi Mahindra “Model - commandant 650 di”. report in ANSYS spreadsheet upon the various loads (5000N, 6685 N and 8000N)and the several materials (Steel, Kevlar and E-Glass Epoxy). In that theory the stagnant search to figure out the cut, trauma and sprain at the several loads (5000N, 6685 N and 8000N)and the various materials (Steel, Kevlar and E-Glass Epoxy).modal report to figure out the laceration corresponding regularity near the several materials (Steel, Kevlar and E-Glass Epoxy). transitory reasoning to figure out the cut, burden and sprain proportionate show and the various loads. By watching the stagnant opinion results the laceration, burden and tension scruples are increases by escalating the masses. the burn standards are reassured E-Glass Epoxy after we connect the inspirit and Kevlar materials and once we equal the math girthes the 8mm algebra depth is the better form. By watching the modal search the damage beliefs are reconciled e-glass epoxy material. So it can be concluded the e-glass epoxy composite material is the better material for leaf spring and 8mm girth numbers form is the better calculation mode.

REFERENCES:

[1] DESIGN AND ANALYSIS OF COMPOSITE LEAF SPRING FOR LIGHT VEHICLES Pankaj Saini¹, Ashish Goel², Dushyant Kumar³.



[2] Design and Analysis of Leaf Spring of an Automobile Using Composite Materials Naveen S 1 , Natarajan R2.

[3] Design and Analysis of a Leaf Spring for automobile suspension system: A Review Baviskar A. C. 1 , Bhamre V. G. 2 , Sarode S. S. 3.

[4] DESIGN AND ANALYSIS OF AOTOMOBILE LEAF SPRING USING ANSYS DevDutt Dwivedi1, V. K. Jain2.