IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 2 Ver. VI (Mar - Apr. 2015), PP 84-100
www.iosrjournals.org

Design and Analysis of Front Mono Suspension in Motorcycle

[1]Karthik Dhayakar, [2]T.kamalahar, [3]T.Vinu sakthi,
[4]R.S.Manoj, [5]S.Shanmugasundaram

Abstract: *The main part for a vehicle suspension is the shock absorber, which is manufactured for reducing shock impulse. Shock absorber work on the principle of fluid displacement on compression and expansion cycle. They are used in motorcycles for providing better handling, prompt braking, safety and comfort by keeping the passengers isolated from road noise, bumps and vibration. The common type of the front suspension in motorcycle is Telescopic forks which are replaced by the Mono Shocks that gives a superior vehicle handling and provides safety while braking. Mono shock also allows the rider to fine tune the machine to give better control over the machine when riding. The springs in Mono Shock have been designed by taking considerations of many practical conditions like dynamic resistances, road tracks and aerodynamic properties. In this design the uneven vibrations in the telescopic forks have been balanced by using the Mass Centralization concept in the pivoted centre point of the front suspension in the motorcycle using Mono Shocks. The Mono Shock geometry gives a rising rate of damping characteristics to the front suspensions and the designed springs used to restrict a downgraded dynamics when it returns to the immobility state posterior to humps and bumps. This design of front suspension using mass centralization concept may antiquate the present telescopic forks*

I. Introduction

The suspension system is the main part of the vehicle, where the shock absorber is designed mechanically to handle shock impulse and dissipate kinetic energy. In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. While shock absorbers serve the purpose of limiting excessive suspension movement, their intended sole purpose is to damp spring oscillations. Hysteresis is the tendency for otherwise elastic materials to rebound with less force than was required to deform them. Hence, the designing of suspension system is very crucial. In modeling the time is spent in drawing the coil spring model and the front suspension system, where risk involved in design and manufacturing process can be easily minimized. So the modeling of the coil spring is made by using SOLID WORKS. Later the model is imported to ANSYS for the analysis work.

II. Literature Survey

Front suspension:

Motorcycle's suspension serves a dual purpose: contributing to the vehicle's handling and braking, and providing safety and comfort by keeping the vehicle's passengers comfortably isolated from road noise, bumps and vibrations. The typical motorcycle has a pair of fork tubes for the **front suspension.**

The most common form of front suspension for a modern motorcycle is the telescopic fork. Other fork designs are girder forks, suspended on sprung parallel links and bottom leading link designs. Some manufacturers used a version of the swinging arm for front suspension on their motocross designs.

The top of the forks are connected to the motorcycle's frame in a triple tree clamp which allows the forks to be turned in order to steer the motorcycle. The bottoms of the forks are connected to the front axle around which the front wheel spins. On typical telescopic forks, the upper portion, known as the fork tubes, slide inside the fork bodies, which are the lower part of the forks. As the tubes slide in and out of the body they are telescoping, thus the term telescopic forks. The fork tubes must be smooth to seal the fork oil inside the fork, and typically have a mirrored finish, though some fork tubes, especially those on off-road motorcycles, are enclosed in plastic protective sleeves, known as gaiters. A shock absorber consists of springs which determine posture and cushioning buffer action and a damper which suppresses vibration.

On 2-wheeled vehicles, shock absorbers are separated into the categories of the “front fork” and “rear cushion”. The front fork: Front fork serves as rigidity component just like a frame. Vehicle specific rigidity given to present run out while braking and changing the direction of a wheel though handle operations. Maintain balance of vehicle frames stability and secures straight running stability as well as rotationality of the vehicles. The front fork prevents excessive weight on the front wheel during drastic sudden applications the break, softens bumping when driving on rough road surfaces. The front fork maintains proper damping through traction with the road surface.

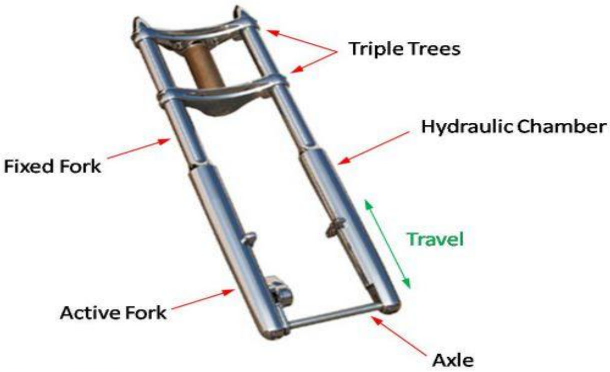
Shock Absorbers:

The shock absorbers damp out the motions of a vehicle up and down on its springs. They also must damp out much of the wheel bounce when the unsprung weight of a wheel, hub, axle and sometimes brakes and differential bounces up and down on the springiness of a tire. Some have suggested that the regular bumps found on dirt roads are caused by this wheel bounce, though some evidence exists that it is unrelated to suspension is a mechanical or hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy which is then dissipated. It controls the travel speed and resistance of the vehicle's suspension. An undamped car will oscillate up and down. With proper damping levels, the car will settle back to a normal state in a minimal amount of time. Most damping in modern vehicles can be controlled by increasing or decreasing the resistance to fluid flow in the shock absorber.

III. Existing System:

Telescopic Forks:

Motorcycles today use telescopic forks for the front suspension. The forks can be most easily understood as simply large hydraulic shock absorbers with internal coil springs. They allow the front wheel to react to imperfections in the road while isolating the rest of the motorcycle from that motion.



The top of the forks are connected to the motorcycle's frame in a triple tree clamp, which allows the forks to be turned in order to steer the motorcycle. The bottom of the forks are connected to the front axle around which the front wheel spins. On typical telescopic forks, the upper portion, known as the fork tubes, slide inside the fork bodies, which are the lower part of the forks. As the tubes slide in and out of the body they are telescoping, thus the term telescopic forks. The fork tubes must be smooth to seal the fork oil inside the fork, and typically have a mirrored finish, though some fork tubes, especially those on off-road motorcycles, are enclosed in plastic protective sleeves, known as gaiters.

Upside-down forks: Also known as inverted forks, are installed inverted compared to conventional telescopic forks. The slider bodies are at the top, fixed in the triple clamps, and the stanchion tubes are at the bottom, fixed to the axle.

Types Of Forks:

Cartridge forks: Cartridge forks use internal cartridges with a valving system. The valve will have a number of shims of varying thicknesses that cover the orifices in the valve to control the damping of the fork on high and low speed bumps. Some of the leaf springs lift with little force allow fluid to flow through the orifice. Other springs require greater force to lift and allow flow. This gives the fork digressive damping, allowing it to be stiff over small bumps, but get relatively softer over larger bumps.Also, the springs only allow flow in one direction, so one set of springs controls compression damping, and another rebound damping. This allows the dampings to be set separately.

Gas-charged cartridge forks

In 2007 the gas-charged bolt-in cartridge set for modern sportbike forks became available. This kit is legal for supersport styled classes of racing, which regulations do not allows a complete fork replacement, and force competitors to use the stock fork casings.

Saxon-Moto fork:

The Saxon-Motodd has an additional swingarm that mounts to the frame and supports the spring. This causes the rake and trail to increase during braking instead of decreasing as with traditional telescopic forks.

Hossack fork: The Hossack separates completely the suspension from steering forces. It was developed by Norman Hossack though used by Claude Fior and John Britten on racebikes. Hossack himself described the system as a 'steered upright'. In 2004 BMW announced the K1200S with a new front suspension that is based upon this design.

Proposal System

Monoshock in Front Suspension:

On a motorcycle with a mono-shock suspension, a single shock absorber connects the rear swingarm to the motorcycle's frame. Typically this lone shock absorber is in front of the rear wheel, and uses a linkage to connect to the swing arm. Such linkages are frequently designed to give a rising rate of damping for the rear. Mono-shocks are said to eliminate torque to the swing arm and provide more consistent handling and braking.

The principal design alternative to the twin-tube form has been the mono-tube shock absorber which was considered a revolutionary advancement when it appeared in the 1950s. As its name implies, the mono-tube shock, which is also a gas-pressurized shock and also comes in a coil over format, consists of only one tube, the pressure tube, though it has two pistons. These pistons are called the working piston and the dividing or floating piston, and they move in relative synchrony inside the pressure tube in response to changes in road smoothness. The two pistons also completely separate the shock's fluid and gas components. The mono-tube shock absorber is consistently a much longer overall design than the twin-tubes, making it difficult to mount in passenger cars designed for twin-tube shocks. However, unlike the twin-tubes, the mono-tube shock can be mounted either way— it does not have any directionality. It also does not have a compression valve, whose role has been taken up by the dividing piston, and although it contains nitrogen gas, the gas in a mono-tube shock is under high-pressure (260-360 p.s.i. or so) which can actually help it to support some of the vehicle's weight, something which no other shock absorber

An improvement in motorcycle frames having a generally closed configuration with generally horizontal upper and lower frame members and spaced generally front and rear vertical members transverse to and connecting said upper and lower members to form a closed configuration and a drive sprocket is provided in the form of a pair of spaced generally horizontally extending swing arms on each side of said frame and a rear wheel, said arms extending rearward from the rear member and each pivoted adjacent one end on said frame, a generally vertical link connecting the other ends of said swing arms and receiving an axle shaft for the rear wheel intermediate the two swing arms, spring means pivotally connected at one end to at least one swing arm of each pair of swing arms at the other end to at least one of the other swing arms and the frame and link means in one of said pivot connections of said spring means whereby deflection of said swing arms from a first normal position upwardly around their pivot at the frame causes a progressively rising rate of deflection of said spring means weight and cost considerations, structures are not made more rigid than necessary.

3.1.1 Advantages:

- Mono-shocks eliminate torque to the swing arm and provide more consistent handling and braking.
- They are also easier to adjust, since there's only one shock to adjust, and there is no worry about matching two shocks.
- They are also easier to adjust, since there's only one shock to adjust, and there is no worry about matching two shocks.
- Also, the linkages used to connect the shock to the swing-arm are frequently designed to give a rising rate of damping for the rear.
- The monoshock improves both the ride and handling if tuned well.
- The simple reason for it being better can be understood by the following explanation- "Whenever you encounter a bump on a Motorcycle with two shocks, both the shocks compress, but there is never a situation when both of them compress for the equal length. This leads to downgraded dynamics when it comes to stability. But with a single shock absorber, this problem is solved.

- In a recent test conducted by Bike Magazine, Pulsar, Apache and Unicorn were pitted against each other on a test track. Although the unicorn was not the fastest, they said it is the most confidence inspiring and the most balanced.

Upper limit for that vehicle's weight. This allows the vehicle to perform properly under a heavy load when control is limited by the inertia of the load. Riding in an empty truck used for carrying loads can be uncomfortable for passengers because of its high spring rate relative to the weight of the vehicle.

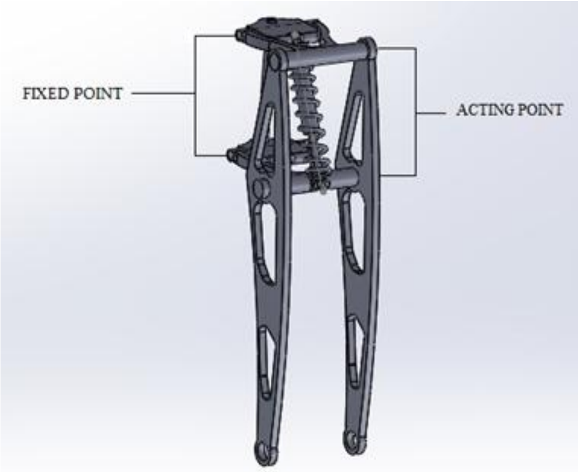
IV. Design

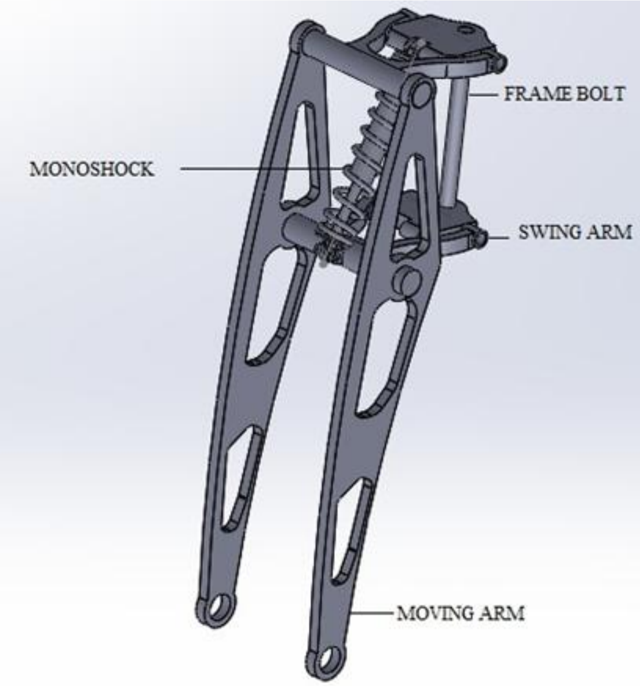
4 .1 Design Of Frame:

The design proposal of the frame of the front suspension of motorcycle using SOLID WORKS.

Design Of The Frame With Spring:

Parts and Joints:





Calculation:

Mean diameter of coil=35 mm (D)
Diameter of the wire (d) = 8mm
Total no of coils n1 =10
Height (h) = 200 m
Outer diameter of spring coil Do = D + d
= 35+8
= 43 mm
Active no of turn = 8
Assume
Weight of bike = 131 kg
Weight of 1 person = 75 kg
Weight of 2 persons = 75×2 = 150 kg
Weight of bike + person = 263 kg
Assume dynamic loads
Rear suspension + front suspension
= 400% + 40%
=80%
80% 263kg = 210 kg
Consider dynamic loads:
W= 342 kg = 3355N

Single shock absorber= w/2= 3355/2= 1677 N=w1
Second shock absorber= w/2= 1677/2= 838.50= w2

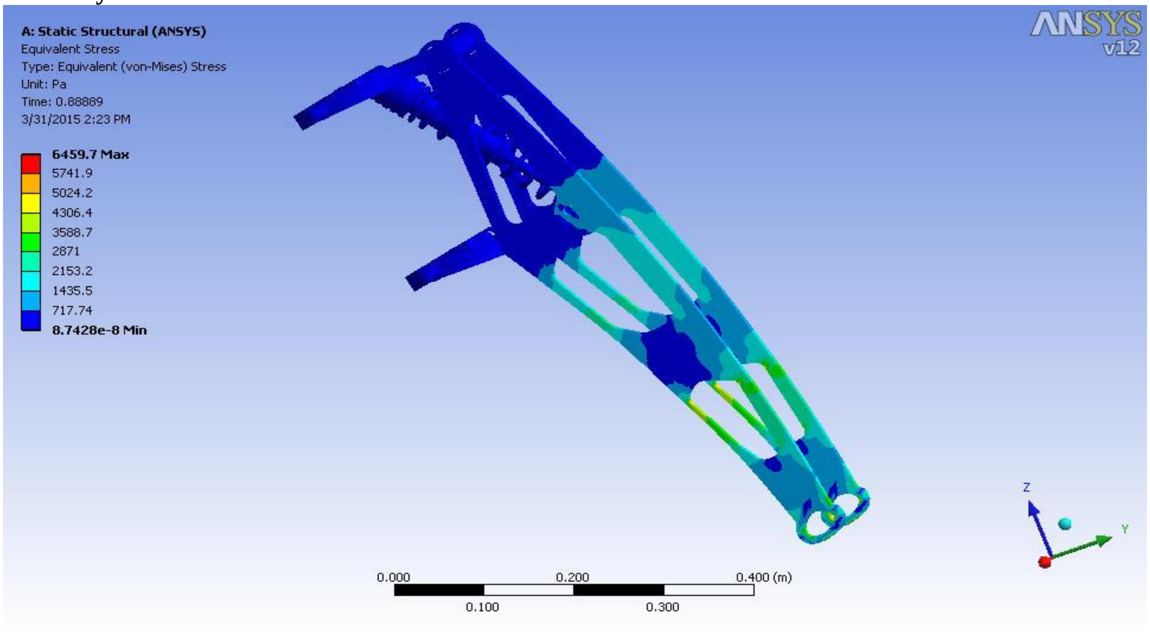
W= w1+w2
W= 1677 + 838
W= 2515 N
Spring index (S) = WD3n/G.d4 = 45.94
C= spring index = D/d = 35/8 = 4
Solid length Ls=n1×d=10×5= 50 mm

Free length of spring
Lf = solid length + compression + clearance
= 50 mm+45.94+ (45.94+0.15)
= 136.43mm
K = w/8 =54.74
P = L1-L3/8n1+d
T = k3×8 WD/trd3; k3 =8.14
T = 636.89

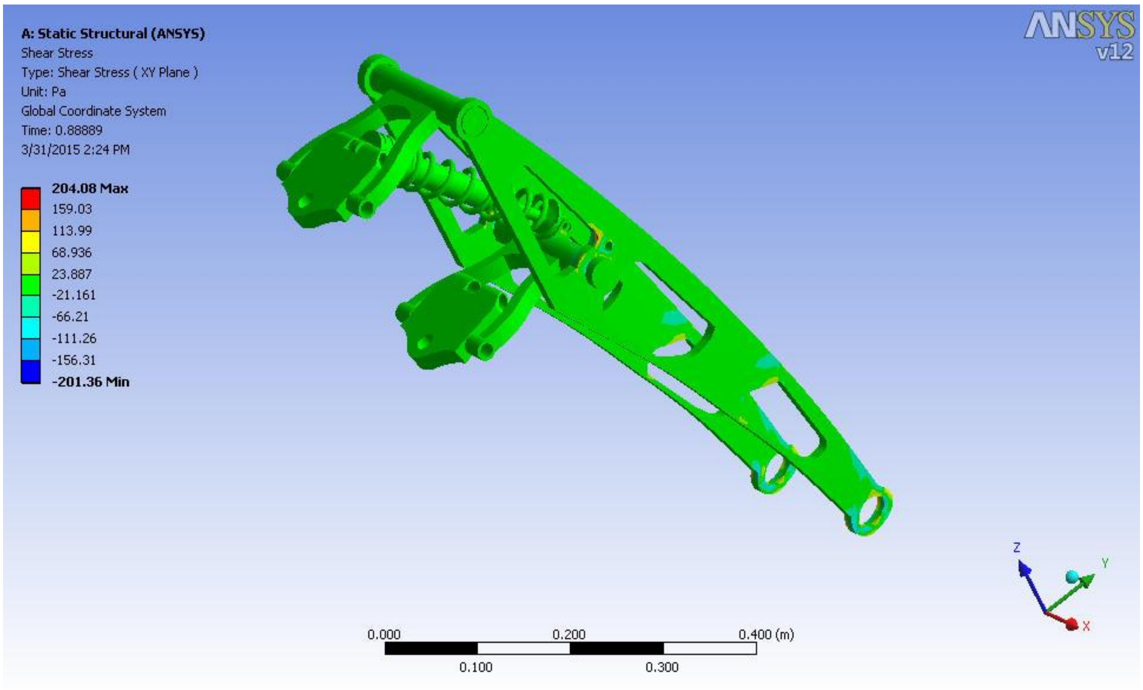
S.no	Loading		Stress on the shock absorb coil spring (mpa)		Deformation of the shock absorber coil spring	
	Description	Load	Present design	Modified design	Present	Modified
1	Bike load	131	307.666	214.68	10.986	6.124
2	Bike load +1 person	206	512.6	400.24	18.227	9.260
3	Bike load +2 person	281	716.78	562.59	25.488	13.412

Analysis Of Frame:

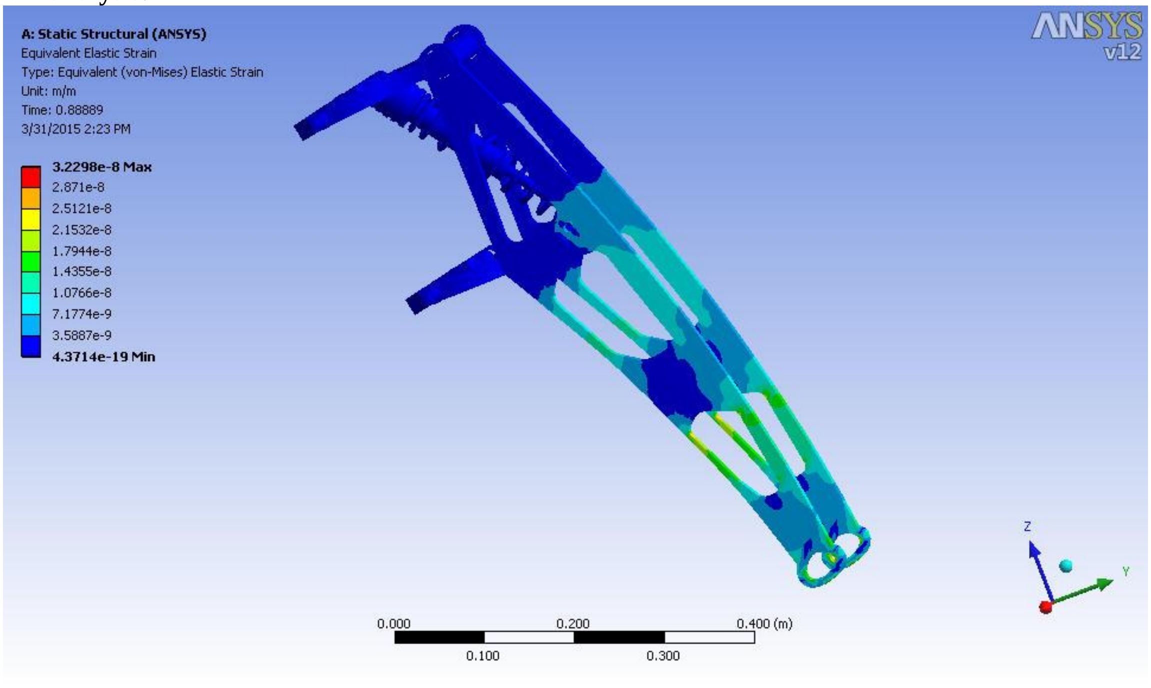
Stress analysis:



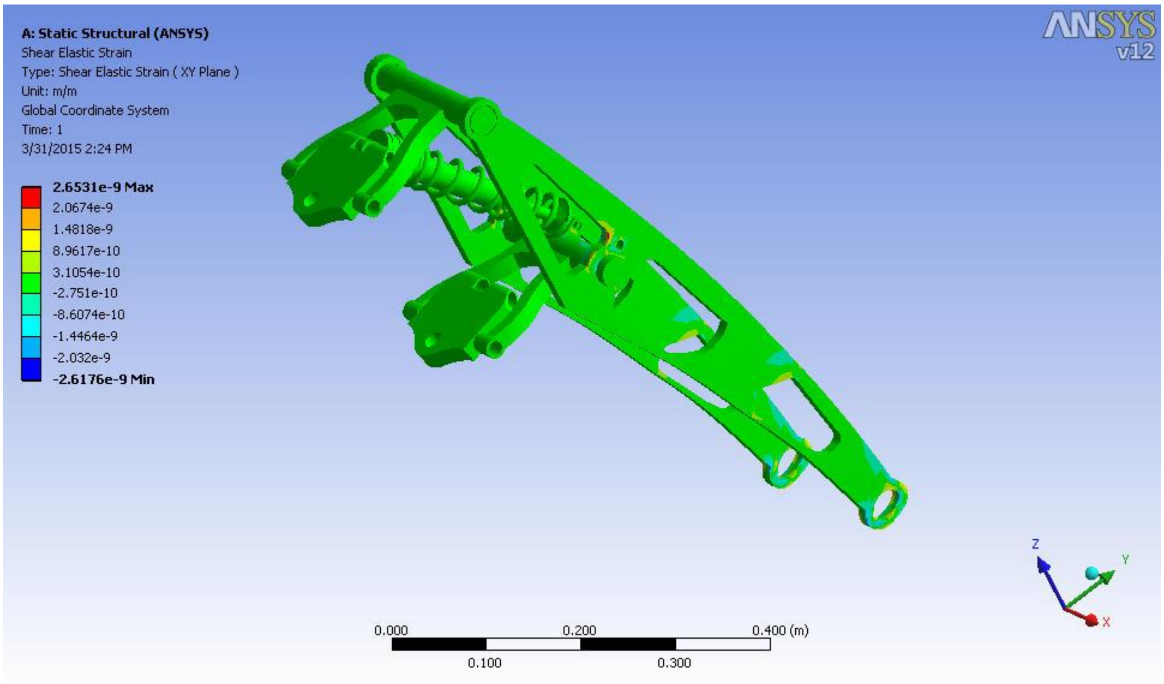
Shear stress:



Strain analysis:

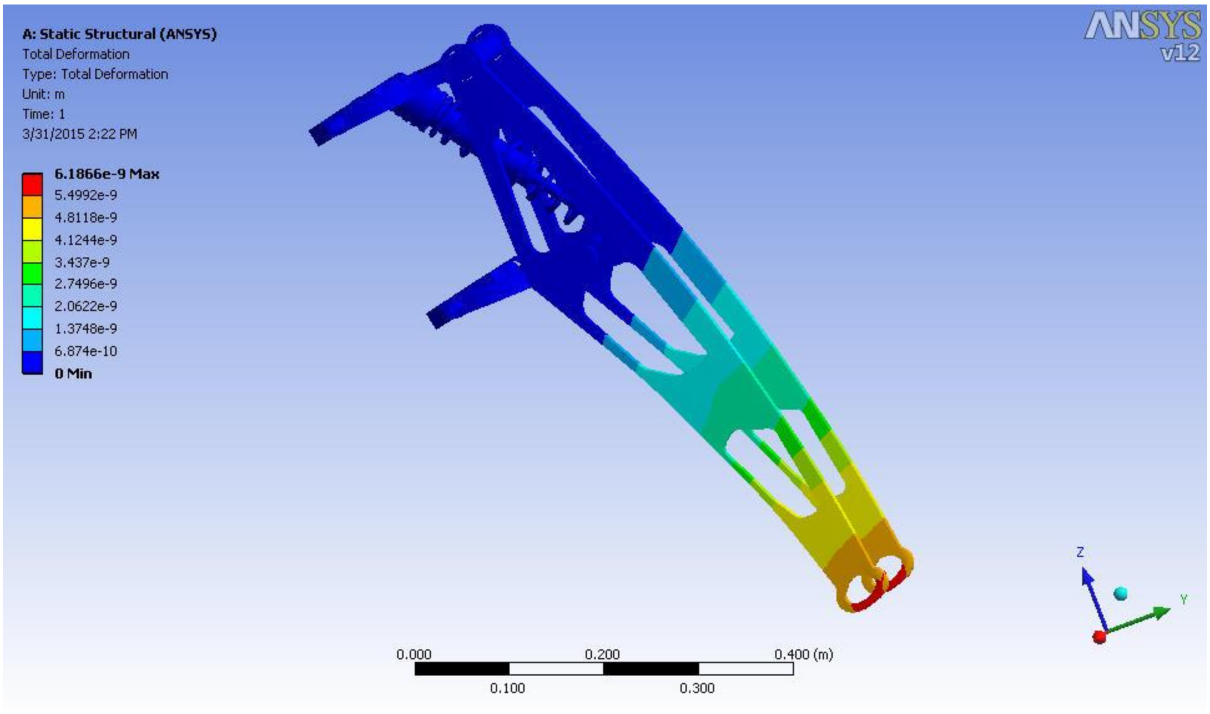


Shear strain:



Total deformation:

Deformation in continuum mechanics is the transformation of a body from a reference configuration to a current configuration. A configuration is a set containing the positions of all particles of the body.A deformation may be caused by external loads and body forces.



Data Analysis:

Units:

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Geometry:

Object Name	Geometry
State	Fully Defined
Definition	
Source	C:\Documents and Settings\ccts\Desktop\karthi-staff\ansys\bike project\final video\without wheel\1213_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Part Color
Bounding Box	
Length X	240. mm
Length Y	400.66 mm
Length Z	760.3 mm
Properties	
Volume	2.2984e+006 mm^3
Mass	18.042 kg
Scale Factor Value	1.
Statistics	
Bodies	12
Active Bodies	11
Nodes	24385
Elements	10662
Mesh Metric	None
Preferences	
Import Solid Bodies	Yes
Import Surface Bodies	Yes
Import Line Bodies	No
Parameter Processing	Yes
Personal Parameter Key	DS
CAD Attribute Transfer	No
Named Selection Processing	No
Material Properties Transfer	No
CAD Associativity	Yes
Import Coordinate Systems	No
Reader Save Part File	No
Import Using Instances	Yes
Do Smart Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Documents and Settings\ccts\Local Settings\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Enclosure and Symmetry Processing	Yes

Parts:

Object Name	Mid parallelo. pin	Part3^Assem1	piston	split	rod parallelo
State	Meshed				Suppressed
Graphics Properties					
Visible	Yes				No
Transparency	1				
Definition					
Suppressed	No				Yes
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Structural Steel				
Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	240. mm	25. mm	45. mm	49.029 mm	20. mm

Length Y	49.07 mm	21.557 mm	80.916 mm	128.2 mm	63.464 mm
Length Z	39.734 mm	16.082 mm	102.9 mm	161.6 mm	249.64 mm
Properties					
Volume	74049 mm³	724.79 mm³	21976 mm³	1.286e+005 mm³	78540 mm³
Mass	0.58129 kg	5.6896e-003 kg	0.17251 kg	1.0095 kg	0.61654 kg
Centroid X	1.1825e-005 mm	0.20714 mm	0.20733 mm		-1.5739e-003 mm
Centroid Y	87.573 mm	55.567 mm	85.725 mm	-13.096 mm	-104.84 mm
Centroid Z	9.8909 mm	-83.821 mm	-41.246 mm	-180.76 mm	-98.335 mm
Moment of Inertia Ip1	139.93 kg·mm²	0.27692 kg·mm²	201.5 kg·mm²	1682.9 kg·mm²	3189.6 kg·mm²
Moment of Inertia Ip2	3123.4 kg·mm²	0.27692 kg·mm²	201.04 kg·mm²	1682.3 kg·mm²	3189.6 kg·mm²
Moment of Inertia Ip3	3126.4 kg·mm²	0.55009 kg·mm²	14.491 kg·mm²	221.29 kg·mm²	30.129 kg·mm²
Statistics					
Nodes	2202	226	1575	5281	0
Elements	1084	23	784	2876	0
Mesh Metric	None				

Object Name	part1 parallelogram	part1 parallelogram	Part3 parallelogram	Parallelogram susp.	parallelogram susp.
State	Meshed				
Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Structural Steel				
Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	115.62 mm		210. mm	15. mm	
Length Y	113.38 mm		174.91 mm	228.6 mm	
Length Z	37.92 mm		39.77 mm	760.3 mm	
Properties					
Volume	1.6821e+005 mm³		2.7658e+005 mm³	5.6946e+005 mm³	
Mass	1.3204 kg		2.1712 kg	4.4703 kg	
Centroid X	-8.3056e-003 mm	-8.3035e-003 mm	-3.3211e-004 mm	-97.5 mm	97.5 mm
Centroid Y	-48.836 mm	-89.107 mm	17.487 mm	132.18 mm	
Centroid Z	8.5716 mm	-217.88 mm	-226.36 mm	109.33 mm	109.34 mm
Moment of Inertia Ip1	1007.8 kg·mm²		4700.6 kg·mm²	1.9205e+005 kg·mm²	1.9204e+005 kg·mm²
Moment of Inertia Ip2	1420. kg·mm²		7541.5 kg·mm²	1.8765e+005 kg·mm²	1.8764e+005 kg·mm²
Moment of Inertia Ip3	2330.6 kg·mm²		12016 kg·mm²	4571.9 kg·mm²	
Statistics					
Nodes	1985	2090	1946	1522	1487
Elements	964	1026	927	161	156
Mesh Metric	None				

Object Name	Part3 parallelogram	spring
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Material		
Assignment	Structural Steel	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	

Bounding Box		
Length X	210. mm	48.378 mm
Length Y	175.44 mm	150.17 mm
Length Z	32. mm	190.64 mm
Properties		
Volume	2.7658e+005 mm³	44550 mm³
Mass	2.1712 kg	0.34971 kg
Centroid X	8.0503e-004 mm	0.42351 mm
Centroid Y	58.183 mm	45.793 mm
Centroid Z	9.9524 mm	-97.339 mm
Moment of Inertia Ip1	4700.6 kg·mm²	1472.6 kg·mm²
Moment of Inertia Ip2	7541.4 kg·mm²	1473. kg·mm²
Moment of Inertia Ip3	12016 kg·mm²	150.43 kg·mm²
Statistics		
Nodes	1978	4093
Elements	950	1711
Mesh Metric	None	

Co ordinate system:

Object Name	Global Coordinate System	Coordinate System
State	Fully Defined	
Definition		
Type	Cartesian	
Ansys System Number	0.	
Ansys System		Program Controlled
Origin		
Origin X	0. mm	0.44394 mm
Origin Y	0. mm	45.616 mm
Origin Z	0. mm	-97.669 mm
Define By		Geometry Selection
Geometry		Defined
Directional Vectors		
X Axis Data	[1. 0. 0.]	[0. -0.57801 -0.81603]
Y Axis Data	[0. 1. 0.]	[0. 0.81603 -0.57801]
Z Axis Data	[0. 0. 1.]	[1. 0. 0.]
Principal Axis		
Axis		X
Define By		Geometry Selection
Geometry		Defined
Orientation About Principal Axis		
Axis		Y
Define By		Default
Transformations		
Base Configuration		Absolute
Transformed Configuration		[0.44394 45.616 -97.669]

Connections:

Object Name	Connections
State	Fully Defined
Auto Detection	
Generate Contact On Update	Yes
Tolerance Type	Slider
Tolerance Slider	0.
Tolerance Value	2.2307 mm
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Revolute Joints	Yes
Fixed Joints	Yes

Transparency	
Enabled	Yes

Object Name	Contact Region	Contact Region 2	Contact Region 3	Contact Region 4	No Separation - Part3^Assem1 To split
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	2 Faces		1 Face	3 Faces	2 Faces
Target	2 Faces		1 Face	2 Faces	
Contact Bodies	mid parallelo. pin			Part3^Assem1	
Target Bodies	parallelogram susp.		spring	piston	split
Definition					
Type	Bonded				No Separation
Scope Mode	Automatic				
Behavior	Symmetric				
Suppressed	No				
Advanced					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Pinball Region	Program Controlled				

Object Name	No Separation - piston To split	Bonded - mid parallelo. pin To piston	Bonded - piston To spring	Bonded - split To part1 parallelogram	Bonded - part1 parallelogram To Part3 parallelogram
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	1 Face	2 Faces	1 Face	2 Faces	3 Faces
Target	2 Faces	1 Face		2 Faces	3 Faces
Contact Bodies	piston	mid parallelo. pin	piston	split	part1 parallelogram
Target Bodies	split	piston	spring	part1 parallelogram	Part3 parallelogram
Definition					
Type	No Separation	Bonded			
Scope Mode	Automatic	Manual			
Behavior	Symmetric				
Suppressed	No				
Advanced					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Pinball Region	Program Controlled				

Object Name	Bonded - part1 parallelogram To Part3 parallelogram	Contact Region 15	Contact Region 16	Contact Region 17	Contact Region 18
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	1 Face		2 Faces	
Target	3 Faces	2 Faces		1 Face	
Contact Bodies	part1 parallelogram	Part3 parallelogram		parallelogram susp.	
Target Bodies	Part3 parallelogram	parallelogram susp.		Part3 parallelogram	
Definition					
Type	Bonded				
Scope Mode	Manual	Automatic			
Behavior	Symmetric				
Suppressed	No				
Advanced					

Formulation	Pure Penalty
Normal Stiffness	Program Controlled
Update Stiffness	Never
Pinball Region	Program Controlled

Object Name	Bonded - split To spring	Bonded - part1 parallelogram To Part3 parallelogram	Bonded - part1 parallelogram To Part3 parallelogram	Bonded - part1 parallelogram To Part3 parallelogram	Bonded - part1 parallelogram To Part3 parallelogram
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	1 Face			
Target	1 Face	2 Faces			
Contact Bodies	split	part1 parallelogram			
Target Bodies	spring	Part3 parallelogram			
Definition					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				
Suppressed	No				
Advanced					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Pinball Region	Program Controlled				

Object Name	Bonded - part1 parallelogram To split	Bonded - mid parallelo. pin To piston
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	2 Faces	4 Faces
Target	2 Faces	
Contact Bodies	part1 parallelogram	mid parallelo. pin
Target Bodies	split	piston
Definition		
Type	Bonded	
Scope Mode	Manual	
Behavior	Symmetric	
Suppressed	No	
Advanced		
Formulation	Pure Penalty	
Normal Stiffness	Program Controlled	
Update Stiffness	Never	
Pinball Region	Program Controlled	

Mesh:

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse

Minimum Edge Length	3.847e-002 mm
Inflation	
Use Automatic Tet Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Pinch	
Pinch Tolerance	Please Define
Generate on Refresh	No
Statistics	
Nodes	24385
Elements	10662
Mesh Metric	None

Static structural:

Object Name	Static Structural (B5)
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	ANSYS Mechanical
Options	
Environment Temperature	22. °C
Generate Input Only	No

Object Name	Analysis Settings
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Stress	Yes
Calculate Strain	Yes
Calculate Results At	All Time Points
Analysis Data Management	
Solver Files	C:\Documents and Settings\ccts\Desktop\karthi-staff\ansys\bike project\final video\without

Directory	wheel\1213_files\dp0\SYS-1\MECH\				
Future Analysis	None				
Scratch Solver Files Directory					
Save ANSYS db	No				
Delete Unneeded Files	Yes				
Nonlinear Solution	No				
Solver Units	Active System				
Solver Unit System	Nmm				
Object Name	Fixed Support 2	Force	Force 2	Fixed Support	Fixed Support 3
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	2 Faces	1 Face		4 Faces	3 Faces
Definition					
Type	Fixed Support	Force		Fixed Support	
Suppressed	No				
Define By		Components			
Coordinate System		Global Coordinate System			
X Component		0. N (ramped)			
Y Component		0. N (ramped)			
Z Component		-50. N (ramped)			
Object Name	Solution (B6)				
State	Solved				
Adaptive Mesh Refinement					
Max Refinement Loops	1.				
Refinement Depth	2.				
Object Name	Solution Information				
State	Solved				
Solution Information					
Solution Output	Solver Output				
Newton-Raphson Residuals	0				
Update Interval	2.5 s				
Display Points	All				

Object Name	Total Deformation	Directional Deformation	Equivalent Elastic Strain	Equivalent Stress
State	Solved			
Scope				
Scoping Method	Geometry Selection			
Geometry	All Bodies			
Definition				
Type	Total Deformation	Directional Deformation	Equivalent (von-Mises) Elastic Strain	Equivalent (von-Mises) Stress
By	Time			
Display Time	Last			
Calculate Time History	Yes			
Identifier				
Orientation		X Axis		
Coordinate System		Global Coordinate System		
Use Average			Yes	
Results				
Minimum	0. mm	-4.3136e-004 mm	2.9862e-015 mm/mm	5.9724e-010 MPa
Maximum	8.6628e-003 mm	4.3466e-004 mm	1.1302e-005 mm/mm	2.2605 MPa
Minimum Occurs On	mid parallelo. pin	parallelogram susp.	spring	
Maximum Occurs On	parallelogram susp.		mid parallelo. pin	
Information				
Time	1. s			
Load Step	1			

Substep	1
Iteration Number	1

V. Material Data:

Structural Steel:

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Compressive Ultimate Strength:

Compressive Ultimate Strength MPa
0

Compressive Yield Strength:

Compressive Yield Strength MPa
250

Tensile Yield Strength:

Tensile Yield Strength MPa
250

Tensile Ultimate Strength:

Tensile Ultimate Strength MPa
460

Alternating Stress:

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

Strain-Life Parameters:

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920	-0.106	0.213	-0.47	1000	0.2

Relative Permeability:

Relative Permeability
10000

Isotropic Elasticity:

Temperature C	Young's Modulus MPa	Poisson's Ratio
	2.e+005	0.3

VI. Conclusion

We have designed a Shock Absorber used in bike and we have modeled it using 3D parametric software called Pro/Engineer. The shock absorber design is modified by reducing the diameter and stress analysis is performed. The stress value is lesser in our designed spring than in original which adds an advantage to our design. By comparing the results in the table we could analyse that our modified front suspension has reduced in weight and it is safe. This invention overcomes the prior art disadvantages and provides an esthetically pleasing adjustable front end spring support.

Bibliography

[1]. Bhandari V B.Design of machine elements. New York: Tata McGraw-Hill; 1994.
[2]. Carlson H. Spring designer's handbook. New York: Marcel Dekker Inc.; 1978.
[3]. Shigley J. Mechanical engineering design. New York: McGraw-Hill; 1981.
[4]. John C. Dixon, The Shock Absorber Handbook. John Wiley & Sons, Ltd; 2007.
[5]. R.S. Sharp: Variable Geometry Active Rear Suspension for Motorcycles, Proceedings of AVEC 2000, Ann Arbor, 2000, 389-395
[6]. M. Ahmadian and J. Gravatt: A Comparative Analysis of Passive Twin Tube and Skyhook MRF Dampers for Motorcycle FrontSuspensions, Proceedings of SPIE 2004 Smart Structures and Materials/NDE, San Diego, 2004
[7]. S. Evangelou: The Control and Stability Analysis of Two-Wheeled Road Vehicles, Doctoral Thesis, Imperial College London,2003
[8]. H.B. Pacejka: Tyre and Vehicle Dynamics, Butterworth Heinemann, Oxford, 2002
[9]. W.O. Schiehlen: Recent Developments in Multibody Dynamics. In: Proc. of Asian Conf. Multibody Dynamics 2004 (2nd
[10]. ACMD, Seoul, Korea, August 1-4, 2004). S. S.Kim (ed.). Seoul: Korean Society Mech. Eng. 2004, Paper 108, 586-595
[11]. Cossalter: Motorcycle Dynamics, Race Dynamics, Greendale, 2002
[12]. D.H. Weir and J.W. Zellner: Development of Handling Test Procedures for Motorcycles, SAE 780313, 1978.