



## Investigation for Design Optimization of Bumper of QuadBikeFrame through FrontalImpactSafety

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**Abstract:** The epicentre goal of this study is to optimize design and analysis a quad bike chassis. This is a platform that comprises of various automotive components like chassis for which more durable design is a primary requirement as these vehicles are more concentrated on rider safety parameters and all other requirements. Along with this, an additional parameter considered while designing was to keep the overall price as minimal as possible. In order to accomplish this task, front impact test was conducted and supported with the aid of theoretical calculations. A workaround was introduced to avoid going for high strength material and obtaining the required factor of safety using the low cost and strength material. To attain adequate beam strength in prior bumpers it has generally been necessary to provide reinforcement, often in the form of added bar structure or the section mass has been substantially increased. In order to effectively achieve this requirement, we aimed at introducing a pair of dashpot dampers which aimed at absorbing the higher impact. Below study shows the feasibility in terms of efficiency and construction cost of the system with proper implementation.

**Keywords:** Quad bike frame, bumpers, fluid dashpot damper, PTCCreo, Ansys

### 1. Problem Identification

Quad bikes (also referred to as bikes) are four-wheeled motor bikes that are popular on farms because they are tough and versatile. However, they are also a leading cause of accidental death and injury. Most injuries or deaths are caused by rider inexperience, lack of helmet or other protective equipment and hazardous, dangerous riding. For an safety Purpose We are fitting a Bumper In front of vehicle which provide more safety to a Rider. As we know in ATV bikes, Chances of accident are more, so for an safety purpose we are fitting a bumper which provide safety to rider.

Deaths associated with collisions included collisions with fences, stationary objects and one report of a collision with a motorcyclist. The category of „other“ types of incidents included being thrown from the vehicle and losing control of the vehicle. In collisions or when the rider was thrown from the vehicle, the most common cause of death was traumatic head injuries, in this respect Bumper is important for Safety for Head Injuries.

Quad Bikes Can Cause Death and Injury.

- Not using the machine according to manufacturer instructions – for example to carry passengers

or loads, or not driving safely allowing for the conditions

- Legs (of either rider or passenger) getting caught by the tyres
- The quad bike flipping or rolling while negotiating a steep slope
- The quad bike hitting an obstacle and rolling over
- The rider being hit by a low-hanging obstacle, such as a branch
- Carrying too much weight, unevenly distributing loads, or not securing them properly – these can tip the quad bike when in motion



- The rider being unfamiliar with the controls and handling characteristics
- Rider inexperience – for example, not knowing that they need to shift body weight to maintain the bike's centre of gravity
- Reckless riding, such as riding too fast or trying to perform stunts
- Poor maintenance, leading to mechanical failure of vital safety equipment such as brakes.

For the manufacturing of Bumper we consider three kinds of material E250A, AISI4130 of quad bike. When we go through the analysis of our first material E 250A then it was failing under the test examination, the test giving factor of safety is less than 1 or we can say on the border of end point, which is not fulfilling our safety criteria then we have another option to select the next material which is AISI 4130. Now when we analyze this material the challenging part of this material is cost issue, the costing of this material is 40% higher than the comparison of E250A, which is not permissible. We try to look forward to build our unit by chipper material for implementing the concept of modifying bumper for quad bike.

## 2. Background

**QUADBIKE:** Quad bike is a class of multi-wheeled vehicles; the most common types are 3- and 4-wheel banned on streets. Handling quad bike is very different from other vehicles, including 2-wheel motor bikes. Operating quad bike is “rider active” where the rider must use his or her body movements to help control the machine.

The first three-wheeled quad bike was the Sperry-Rand Tricart. It was designed in 1967 as a graduate project of John Plessinger at the Cranbrook Academy of Art near



Detroit. The Tricart was straddle-ridden with a sit-in rather than sit-on style.

alot of searching for scrap cars or having one specially made.

### 3. Types of Bumpers

### 4. Methodology

#### I. Plastic Bumper

Most modern cars use a reinforced thermoplastic bumper, as they are cheap to manufacture, easy to fit and absorb more energy during a crash. A majority of car bumpers are custom made for a specific model, so if you are looking to replace a cracked bumper with a similar one, you would have to buy from a specialist dealer. However, many companies now offer alternative designs in thermoplastic, with a range of fittings designed for different models.

Methodology to be adopted depends on our approach towards a particular situation and condition in which experiment is performed. There could be various approaches for the same experiment.

#### II. Body Kit Bumper

### 5. Analysis

Modified cars often now have a full body kit rather than just a front and rear bumper. These kits act as a skirt around the entire body of the car and improve performance by reducing the amount of air flowing underneath the car and so reducing drag. Due to each car's specifications, these have to be specially purchased and can be made from thermoplastic, like a standard bumper, or even of carbon fiber.

We are utilizing analysis programming for examination on the bumper that we had structured and programmed. A variant is ANSYS 19.2. Ansys Inc. is an American organization situated in Canonsburg, Rollin, Pennsylvania. It creates and markets building recreation programming. Ansys programming is utilized to plan items and semiconductors, just as to make attachments that test a

#### III. Carbon Fiber Bumper

Carbon fiber body work is normally the thing of super-cars, but many car companies, and specialist modifiers, are starting to use it for replacement body part on everyday cars. This is because it is very light and is safe during a crash. It is, however, a lot more expensive than normal thermoplastic.

#### IV. Steel Bumper

Originally plated steel was used for the entire body of a car, including the bumper. This material worked well, as it was very strong in a crash, but it was very heavy and had a poor performance. As car engine design has improved, steel bumpers have pretty much disappeared for anything except classic cars. Replacing one involves

itemssturdiness,temperatureappropriation,smooth motionandelectromagneticproperties.

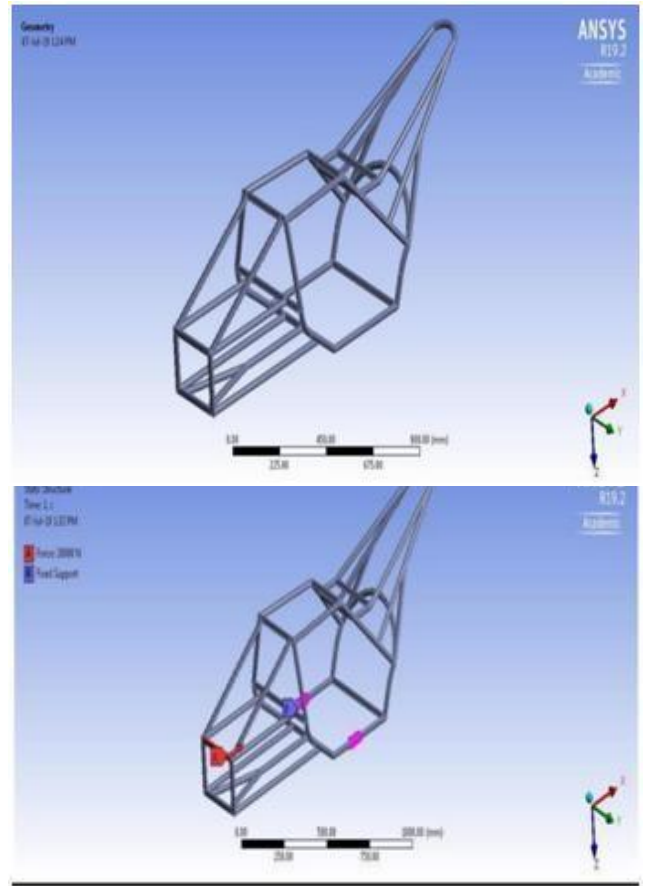
Figure:GeometryofQuadBike

Phase-I  
analysis(AISI4130)

Figure6.2:Deformationplot  
ofquadbike

Phase-I  
analysis(AISI1018)

Figure:Solverdeckview



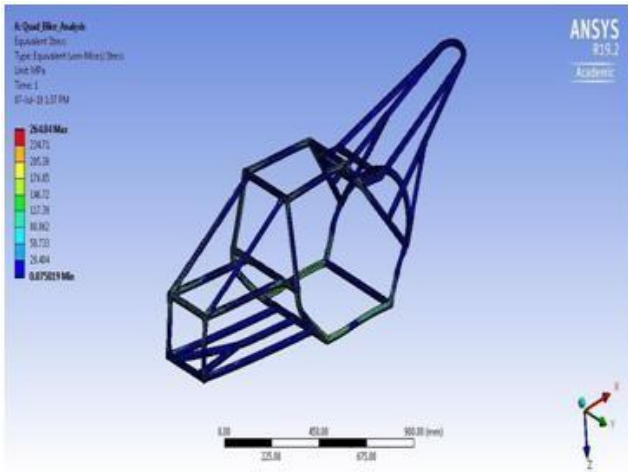


Figure: StrainplotAISI4130

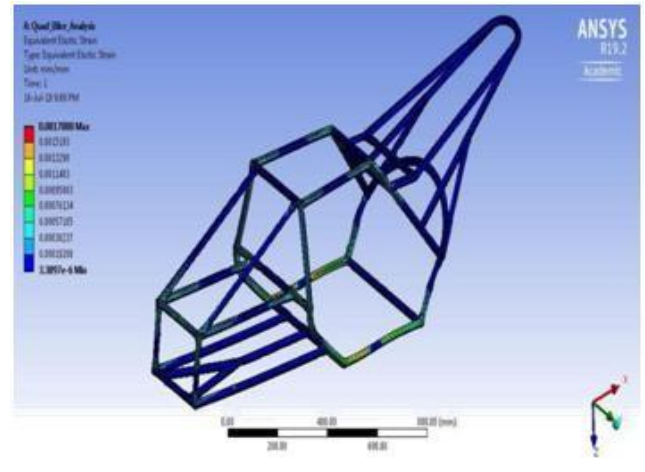


Figure: StressanalysisAISI101  
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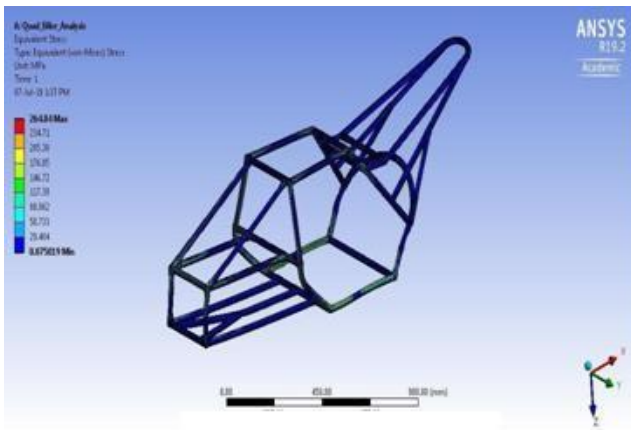


Figure: StressanalysisAISI41  
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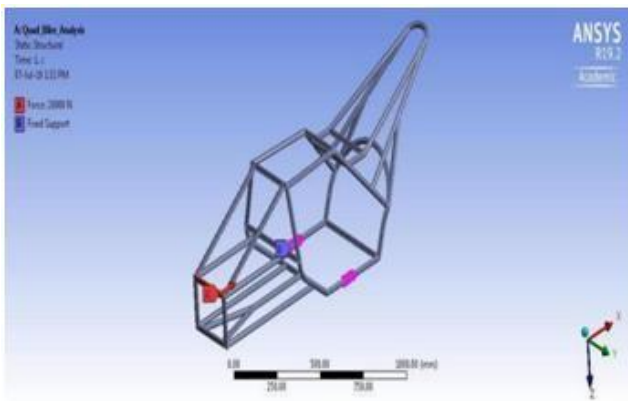


Figure: Solverdeckview

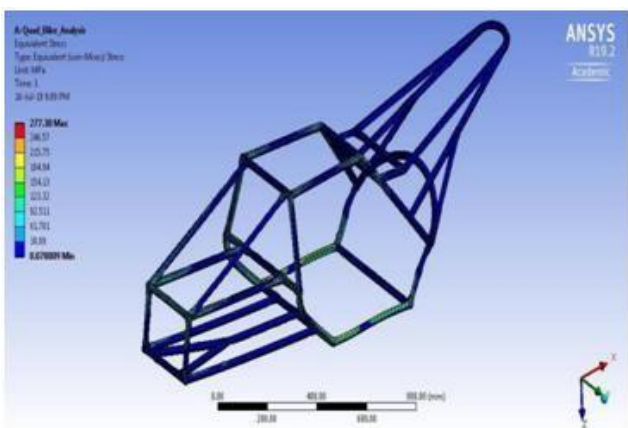
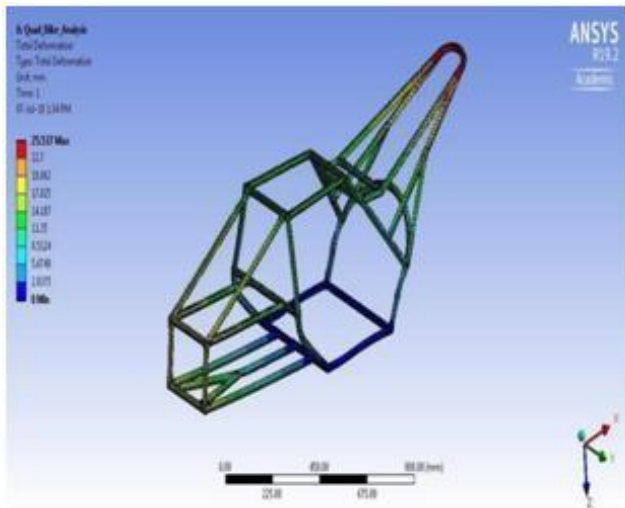
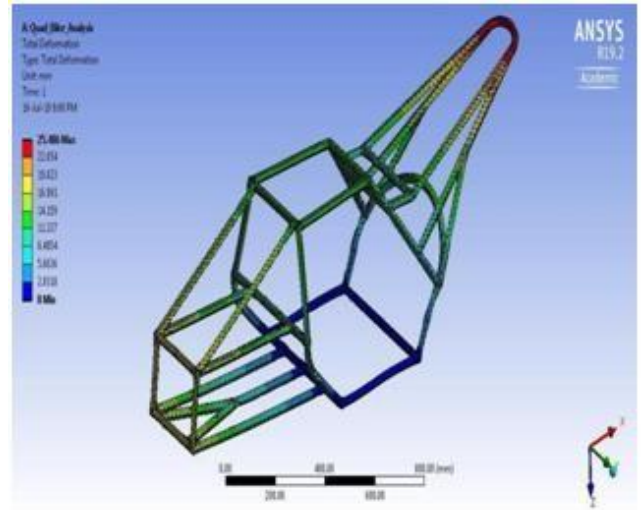


Figure: StrainplotAISI1018

Figure: Deformationplotof AISI1018

Phase– Ianalysis(E250A)

Figure: DeformationplotE 250A







Phase-II analysis(E250A)

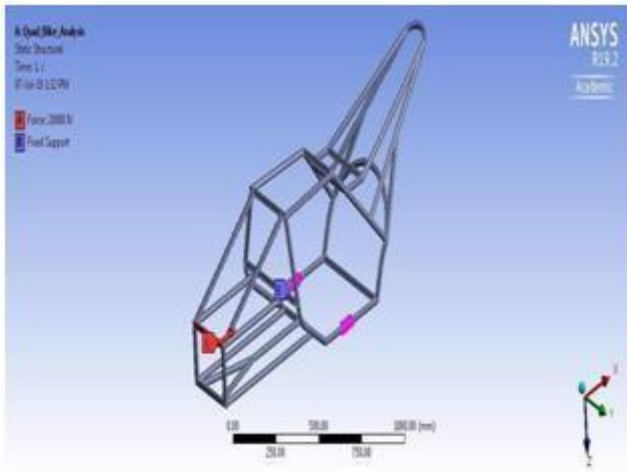


Figure: Solver DeckviewE250A

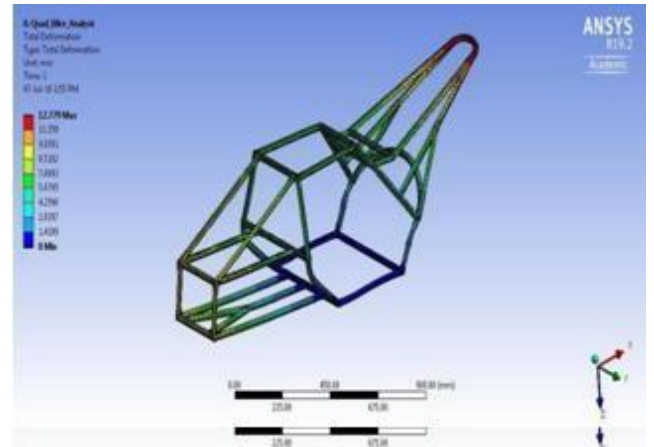


Figure: Deformationplot(Phase-2)

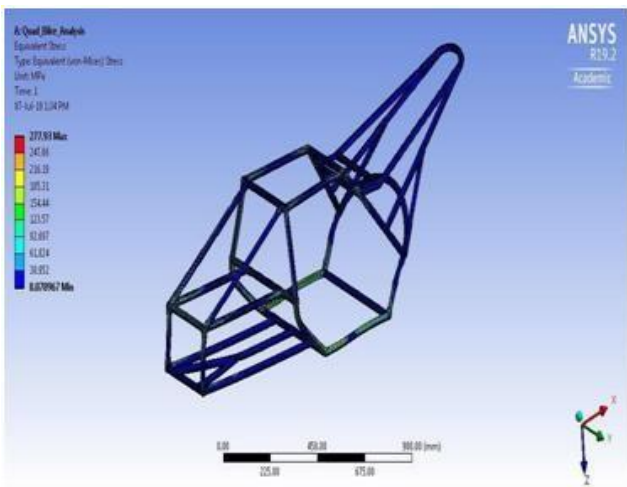


Figure: StrainPlotE250A

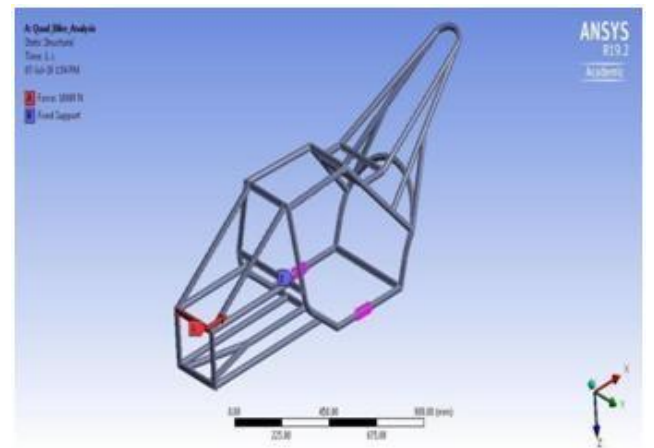


Figure: Solverdeckanalysis

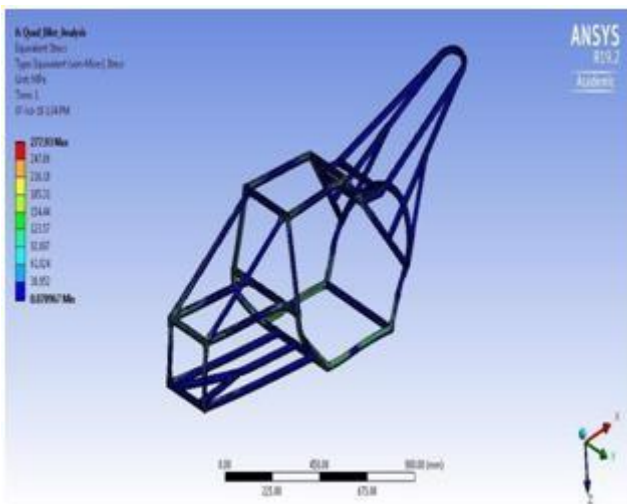


Figure: StressPlotE250A

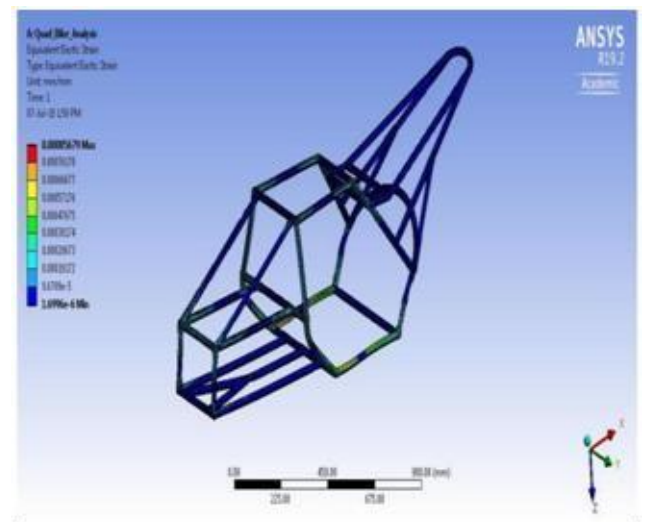
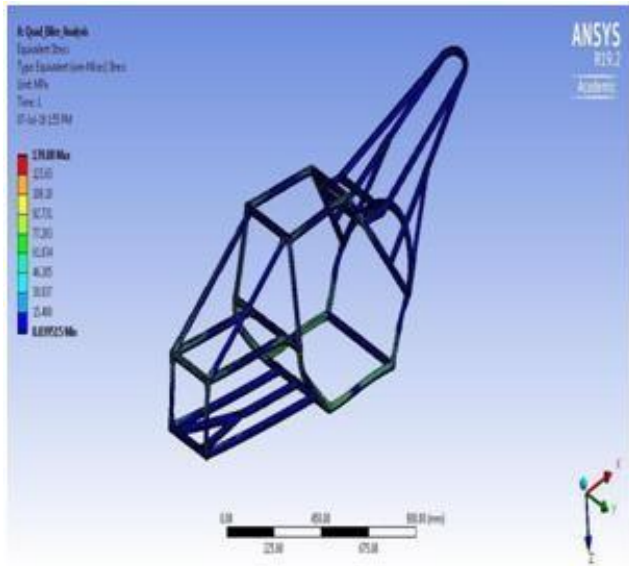


Figure: Strainplot(Phase-2)



6. Results Figure: Stressplot(Phase-2)

Existing bumper system of a Quad bike is modified. The modification is done by incorporating two suspensions or dampers in the bumper system. Two different materials were used for analysis. The analysis is done in two phases. First phase consists of analysis of system without incorporating dampers for both materials. Second phase consists of analysis with inclusion of dampers in existing

system for only one material because increase in FOS was achieved. Resulting obtained FOS's are as follows:

Phase 1: (without bumper unit)

- Material 1<sup>st</sup> = 0.86
- Material 2<sup>nd</sup> = 1.74

Phase 2: (with Bumper Unit)

- Material 1<sup>st</sup> = 1.73

Analysis of cost of both phases is done and it is seen that cost reduction has occurred and it is by Rs.4850. Analysis of weight for both phases is also shown and it is seen that there is an increase of 3.9 kg in the overall weight of the system.

Thus we see that the overall FOS of system is increased. As the FOS has increased, the protection & safety of driver also increases. The chassis is prevented from damaging or reduction in damage is observed due to installation of bumper unit. The bumper system is able to absorb more shocks during frontal collisions.

Cost reduction is seen in the overall system.

Table 8: Analysis results

ANALYSIS RESULTS					
LTS					
Analysis Phase	Parameter	Unit	Result		
			IS2062 (E250 A)	AISI4130	AISI1018
Phase - I (Without unit installed)	Total Deformation	mm	25.537	24.26	25.486
	Vonmises Stresses	MPa	277.93	264.04	277.38
	Elastic Strain	mm/mm	0.0017	0.0016	0.0017
	FOS	-	0.86	1.74	1.19
Phase - II	Total Deformation	mm	12.77		



(With Unit Installed)	ion		9	Eliminated	Eliminated
	Vonmises Stresses	MPa	139.08		
	Elastic Strain	mm/mm	0.00085		
	FOS	-	1.73		

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