

Dynamic Stress Analysis on a Passenger Car Bumper Body Material

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Abstract—Car bumper is one of the main parts which are used as protection for passengers from front and rear collision. The aim of work is to suggest best car bumper material for modern cars. Dynamic analysis done by COSMOS according to the speeds of Federal Motor Vehicle Safety Standards, 208 that is 13.3 m sec⁻¹ (48 km h⁻¹). The materials used for bumper are steel, impact abs plastic and carbon fiber poly-ether-imide (PEI). In FEM analysis impact load was considered. Based on the strain values shown by above materials, the best material was found out.

Key words: Bumper, Impact load, Collision, Dynamic analysis, strain

1. INTRODUCTION

An automobile's bumper is the front-most or rear-most part, ostensibly designed to allow the car to sustain an impact without damage to the vehicle's safety systems. They are not capable of reducing injury to vehicle occupants in high-speed impacts, but are increasingly being designed to mitigate injury to pedestrians struck by cars.

2. STANDARDS

Federal Motor Vehicle Safety Standard No. 215 (FMVSS 215), "Exterior Protection, the standard prohibited functional damage to specified safety-related components such as headlamps and fuel system components when the vehicle is subjected to barrier crash tests at 5 miles per hour (8 km/h) for front and 2.5 miles per hour (4 km/h) for rear bumper systems. New bumper standard was placed in the United States Code of Federal Regulations at 49CFR581 miles per hour (8 km/h) front and rear barrier and pendulum crash tests were required, and no damage was allowed to the bumper beyond a 3/8 in (10 mm) dent and 3/4 in (19 mm) displacement from the bumper's original position.

3. BUMPER MATERIAL CONSIDERATIONS

At one time, most car bumpers were made of steel, today car bumpers can be made from variety of different rubber

materials or plastics molded sleekly around the front and back ends of the vehicles. Bumper systems usually include a reinforcement bar plus energy-absorbing material, such as polypropylene foam. The more a bumper extends from a car body, when other factors remain equal to the more it absorbs crash energy and reduces damage. The majority of modern plastic car bumper system fascia's are made of thermoplastic olefins (TPOs), polycarbonates, polyesters, polypropylene, polyurethanes, polyamides, or blends of these with, for instance, glass fibers, for strength and structural rigidity.

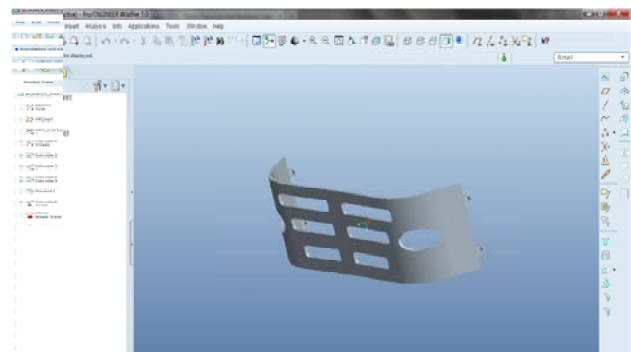


Fig No: 1 3D Model Bumper

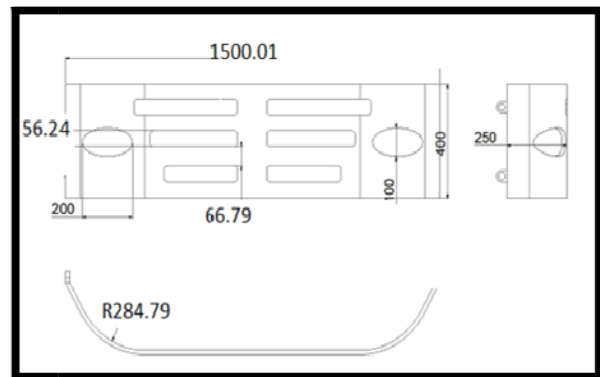


Fig No: 2 2D Drawing of the Bumper

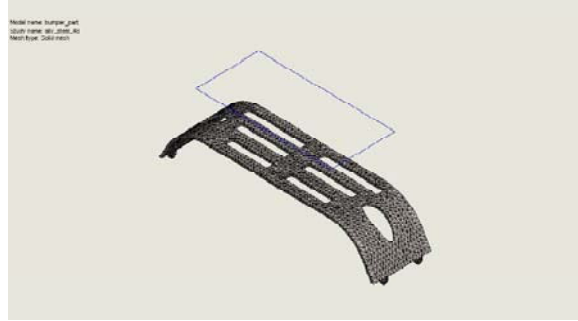


Fig No: 3 Mesh

Table No: 1 Mesh Properties speed @ 48 KMPH

Stress MPa		Nodes	Material
Min	2.5	6000	Alloy Steel
Max	10.50	12000	
Min	1.8	6000	Plastic
Max	25.42	12000	
Min	1.0	6000	PEI
Max	16.5	12000	

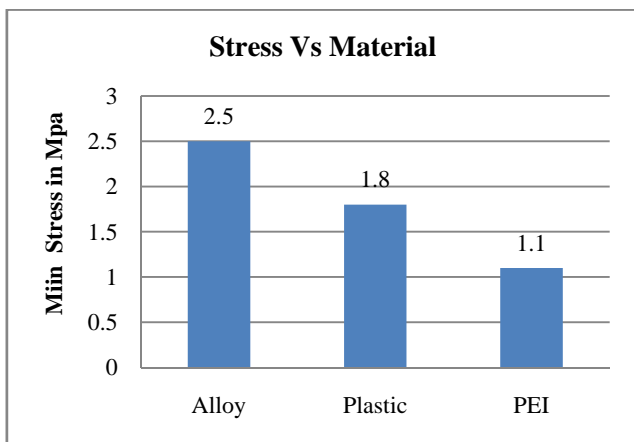
Table No: 2 Mesh Properties @ 100 KMPH

Stress MPa		Nodes	Material
Min	4.0	6000	Alloy Steel
Max	16.45	12000	
Min	3.60	6000	Plastic
Max	40.0	12000	
Min	1.1	6000	PEI
Max	26.45	12000	

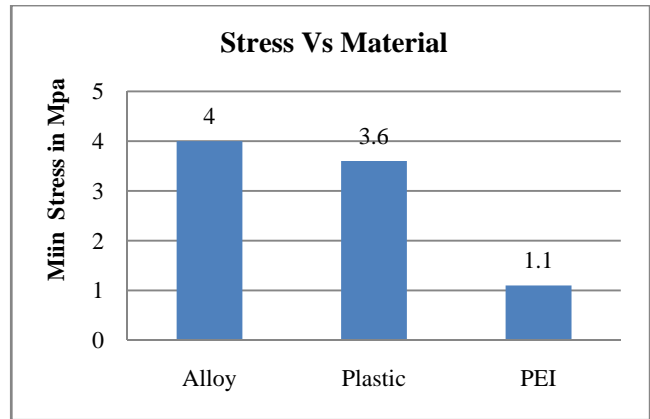
Table No: 3 Mesh Properties @ 120 KMPH

Stress MPa		Nodes	Material
Min	8.0	6000	Alloy Steel
Max	32.0	12000	
Min	5.3	6000	Plastic
Max	79.0	12000	
Min	3.0	6000	PEI
Max	51.2	12000	

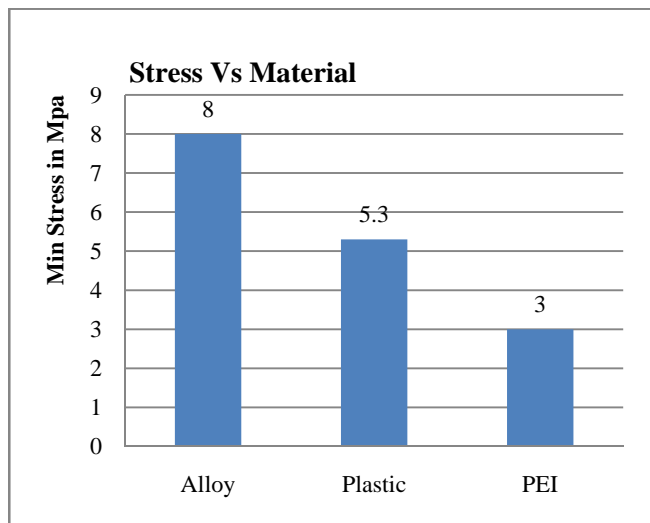
4. GRAPHS



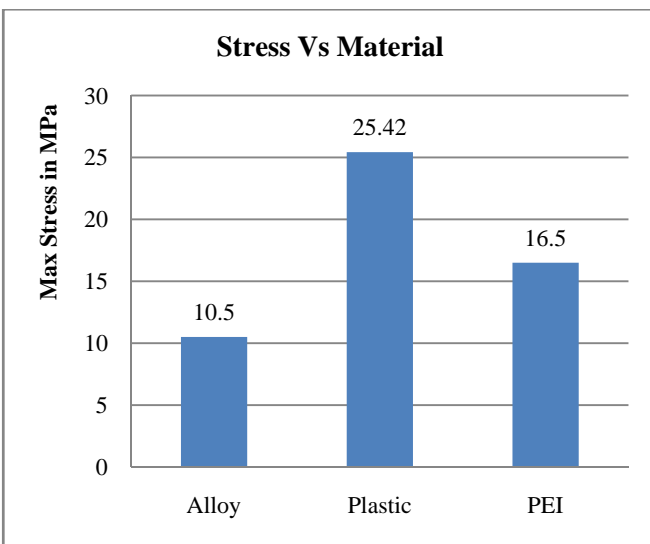
Graph No: 1 Speed @ 48 KMPH



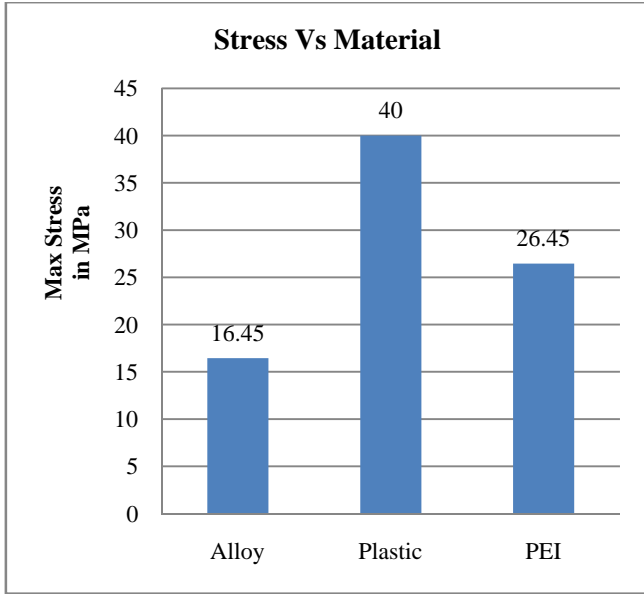
Graph No: 2 Speed @ 100 KMPH



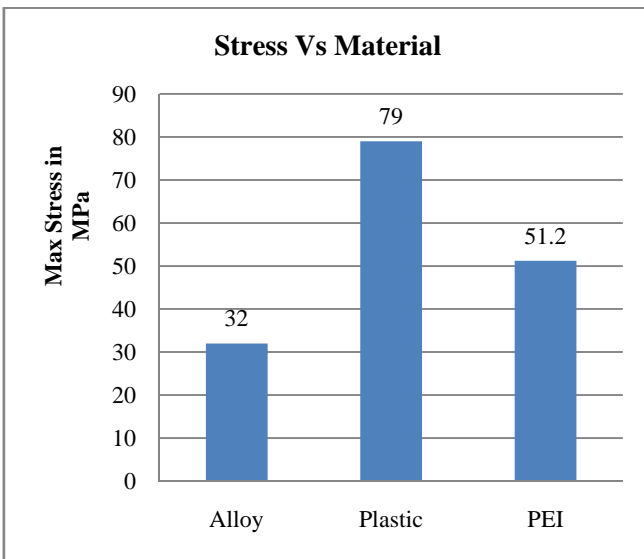
Graph No: 3 Speed @ 120 KMPH



Graph No: 4 Speed @ 40 KMPH



Graph No: 5 Speed @ 100 KMPH



Graph No: 6 Speed @ 120 KMPH

5. RESULTS

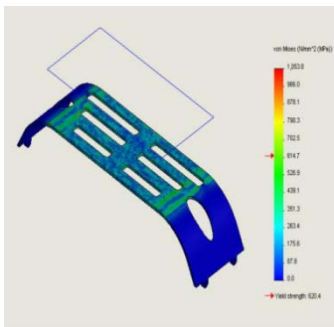


Fig No: 4 @ 48 KMPH

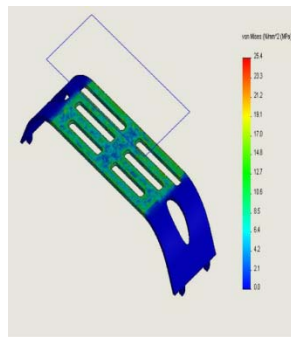


Fig No: 5 @ 100 KMPH

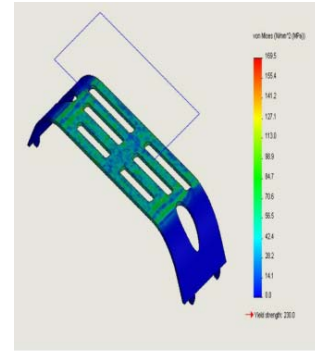


Fig No: 6 @ 120 KMPH

6. CONCLUSION

By considering the equal constant number of minimum and maximum nodes against the speeds viz 48, 100, and 120 KMPH, alloy material has shown least stress distribution, PEI has shown second highest stress distribution and Plastic material has shown highest stress distribution. Hence in case stress distribution alloy material is best suitable as car bumper body material.

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