

DESIGN AND IMPACT ANALYSIS ON A FRAMELESS CHASSIS CONSTRUCTION OF VOLVO BUS FOR DIFFERENT SPEEDS

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ABSTRACT: Automotive chassis is a skeletal frame on which various mechanical parts like engine, tires, axle assemblies, brakes, steering etc. are bolted. The chassis is considered to be the most significant component of an automobile. It is the most crucial element that gives strength and stability to the vehicle under different conditions. Bus chassis is the design and quality of bus chassis depends on the capacity of bus. It can be tailor made according to the needs and can be availed with features like transverse mounted engine, air suspension as well as anti-roll bars. A well manufactured bus chassis offers various benefits like high torque from low revs, superior brake performance and more. Bus chassis designed for urban routes differs from the one manufactured for suburban routes.

For bus frameless chassis construction is used. In this frame less chassis type all the components is attached to the body. All the functions of the frame carried out by the body itself. Due to elimination of long frame it is cheaper and due to less weight most economical also. Only disadvantage is repairing is difficult. This type of frames will effects more in collision of vehicle.

In this project we are reducing the impact by modifying the existing design. Data is collected from the Body construction work shop in Hyderabad. Presently steel is used for chassis construction. The aim of the project is to analyze the frameless chassis with presently used material steel and replacing with composite materials like Carbon Epoxy, E- Glass epoxy. Impact analysis is conducted on chassis for different speeds by varying the materials. We are conducting above analysis for the existing design and for the modified design. Best of the result we will consider for the chassis design. Also we are going to reduce weight of the chassis by using composite materials replacing with steel.

Software used for modeling creo and for analysis COSMOS.

INTRODUCTION TO CHASSIS

The chassis forms the main structure of the modern automobile. A large number of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. During the manufacturing process the body is flexibly bolted to the chassis.

This combination of the body and frame performs a variety of functions. It absorbs the reactions from the movements of the engine and axle, receives the reaction forces of the wheels in acceleration and braking, absorbs aerodynamic wind forces and road shocks through the suspension, and absorbs the major

energy of impact in the event of an accident.

There has been a gradual shift in modern small car designs. There has been a trend toward combining the chassis frame and the body into a single structural element. In this grouping, the steel body shell is reinforced with braces that make it rigid enough to resist the forces that are applied to it. To achieve better noise-isolation characteristics, separate frames are used for other cars. The presence of heavier-gauge steel components in modern separate frame designs also tends to limit intrusion in accidents.

INTRODUCTION OF CHASSIS FRAME:

Chassis is a French term and was initially used to denote the frame parts or Basic Structure of the vehicle. It is the back bone of the vehicle. A vehicle without body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and Tyres, Suspension, Controlling Systems like Braking, Steering etc., and also electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. So it is also called as Carrying Unit.

LAYOUT OF CHASSIS AND ITS MAIN COMPONENTS:

The following main components of the Chassis are

1. Frame: it is made up of long two members called side members riveted together with the help of number of cross members.
2. Engine or Power plant: It provides the source of power
3. Clutch: It connects and disconnects the power from the engine fly wheel to the transmission system.
4. Gear Box
5. U Joint
6. Propeller Shaft
7. Differential

FUNCTIONS OF THE CHASSIS FRAME:

1. To carry load of the passengers or goods carried in the body.
2. To support the load of the body, engine, gear box etc.,
3. To withstand the forces caused due to the sudden braking or acceleration
4. To withstand the stresses caused due to the bad road condition.
5. To withstand centrifugal force while cornering

FRAMELESS OR INTEGRAL FRAME CHASSIS

Body-on-frame is an automobile construction method. Mounting a separate body to a rigid frame that supports the drivetrain was the original method of building automobiles, and its use continues to this day. The original frames were made of wood (commonly ash), but steel ladder frames became common in the 1930s. It is technically not comparable to newer monocoque designs, almost no modern vehicle uses it (other than trucks).

Advantages

- Easier to design, build and modify (less of an issue now that Computer-Assisted Design (CAD) is commonplace, but still an advantage for coach-built vehicles).
- Quieter, because the stresses do not pass into the body, which is isolated from the frame with rubber pads around the attachment bolts. Less significant lately, but earlier bodies would squeak and rattle, ever more as they rusted, lubricants drained, and fasteners loosened. Isolated bodies had a lesser degree of these modes of aging.
- Easier to repair after accidents. Grand-Am allows tubular spaceframe cars to replace their monocoque counterparts, as the cars can easily be repaired with new clips.
- Could allow a manufacturer to easily sub-contract portions of work, e.g. as when Austin subcontracted the aluminum body work of the Austin A40 Sports to Jensen Motors.

Disadvantages

- Heavier than unibody - lower performance and/or higher fuel consumption.
- Far less resistant to torsional flexing (flexing of the whole car in corners) - compromising handling and road grip.
- No crumple zone - higher rate of death and serious injury. Some cars have adopted a "front clip" and "rear clip" format similar to what is used in NASCAR race cars where the car is split into three sections, and the clips absorb the impact, allowing the "clip" to be replaced when repairing the car.^[3]
- Structurally poor utilization of material.

- - Although the share of passenger transportation in buses is relatively small compared to private cars, there is also a tendency of increasing demand in some cases like limited accessible city centers and a trend to specialization as well.

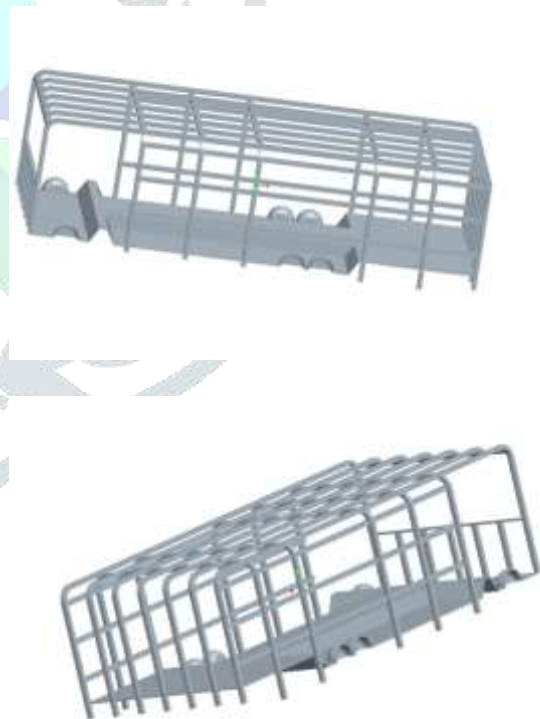
INTRODUCTION TO CAD

Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.

INTRODUCTION TO SOLIDWORKS

SolidWorks is a 3D mechanical CAD (computer-aided design) program that runs on Microsoft Windows and is being developed by Dassault Systèmes SolidWorks Corp., a subsidiary of Dassault Systèmes, S. A. (Vélizy, France). SolidWorks is currently used by over 1.3 million engineers and designers at more than 130,000 companies worldwide. FY2009 revenue for SolidWorks, was 366 million dollars.

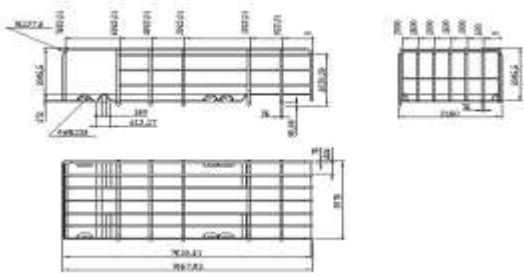
PRESENT MODEL



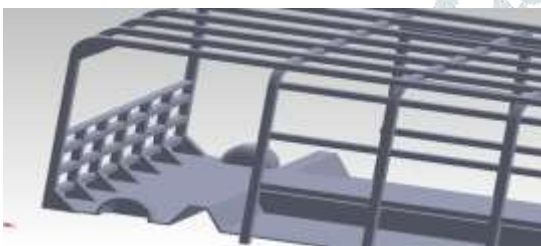
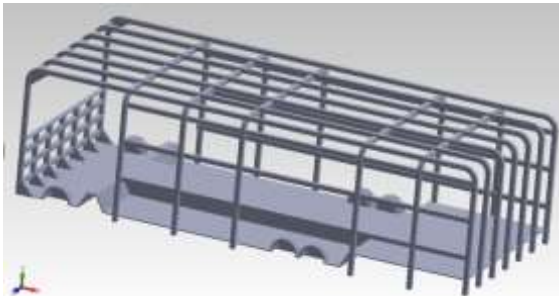
DESIGN OF COMMERCIAL VEHICLE CHASSIS

- Transportation industry plays a major role in the economy of modern industrialized and developing countries. The following facts are of special importance for the manufacturers of commercial vehicles:
- - The total and relative volume of goods carried on trucks is high and still dramatically increasing. This results in acceptance and environmental problems.
- - The transportation task itself becomes more and more specialized. Therefore, a large variety of different vehicles is required.

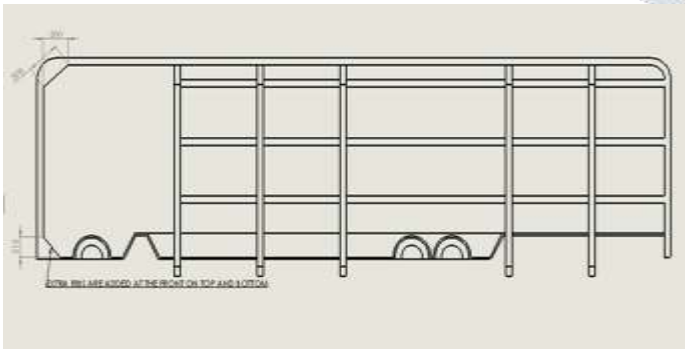
4.2.1 2D DRAWING



4.3 MODIFIED MODEL



4.3.1 2D DRAWING



represent the displacement with in the element in terms of the displacement at the nodes of the element.

INTRODUCTION TO COSMOSWORKS

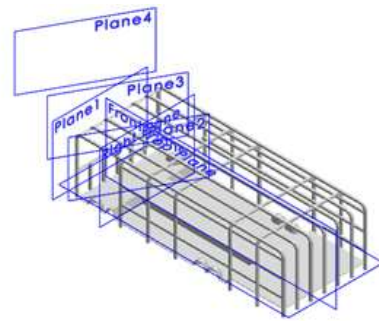
Cosmosworks is a useful software for design analysis in mechanical engineering. That’s an introduction for you who would like to learn more about COSMOSWorks. COSMOSWorks is a design analysis automation application fully integrated with SolidWorks.

IMPACT ANALYSIS OF FRAME LESS CHASSIS

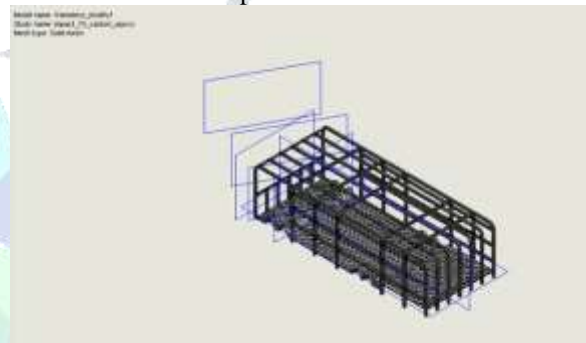
6.1 PRESENT DESIGN

6.2 SPEED – 75km/hr

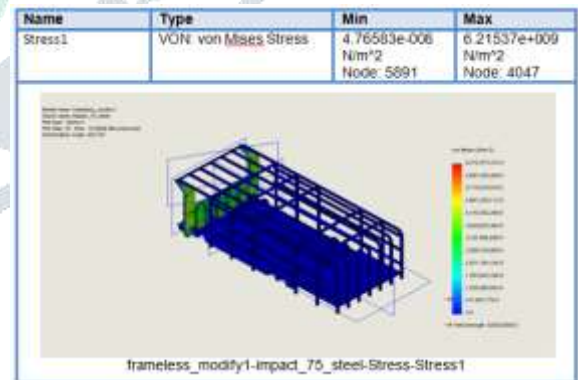
6.3 ALLOY STEEL



Imported model



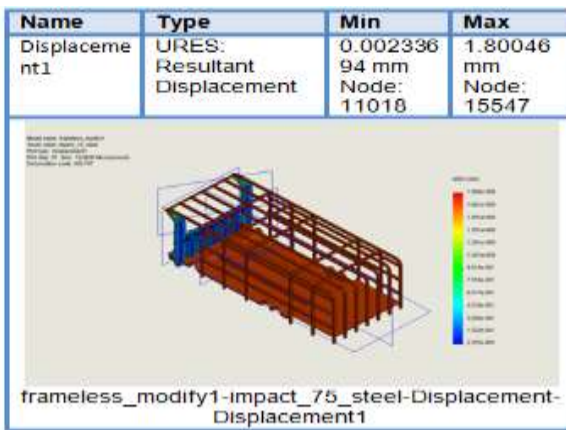
Meshed model



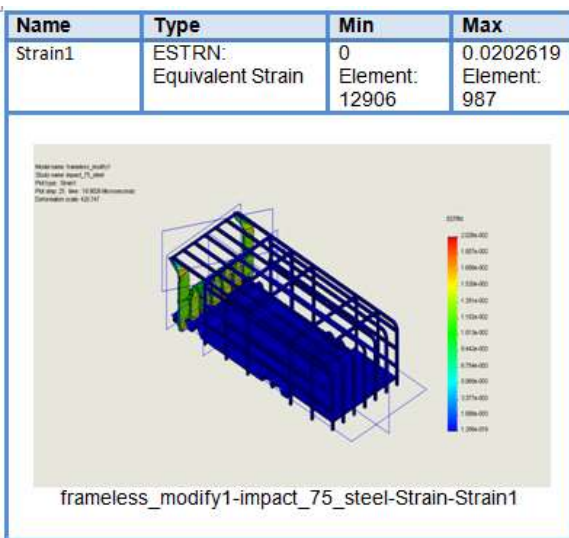
Stress

INTRODUCTION TO FEA

The Basic concept in FEA is that the body or structure may be divided into smaller elements of finite dimensions called “Finite Elements”. The original body or the structure is then considered as an assemblage of these elements connected at a finite number of joints called “Nodes” or “Nodal Points”. Simple functions are chosen to approximate the displacements over each finite element. Such assumed functions are called “shape functions”. This will



Displacement



Strain

7.1 PRESENT DESIGN

	alloy steel			carbon epoxy			e-glass epoxy		
	stress N/mm ²	displacement mm	strain	stress N/mm ²	displacement mm	strain	stress N/mm ²	displacement mm	strain
75 Km/hr	6210	1.80046	0.020 261	678	0.459936	0.002 79	361.9 13	0.44251	0.095 43
150 Km/hr	3251.7 4	0.950993 666	0.010 666	1357 07	0.920092	0.005 60	725.3 64	0.883161	0.010 87
300 Km/hr	6214.6 1	1.80024	0.020 259	2710	1.84126	0.011 23	1455. 94	1.77189	0.021 82
WEIG HT (Kg)	10864			2257.65			2822		

7.2 MODIFIED DESIGN

	ALLOY STEEL			CARBON EPOXY			E-GLASS EPOXY		
	STRE SS N/mm ²	DISP mm	STRA IN	STRES S N/mm ²	DISP mm	STRA IN	STRE SS N/mm ²	DISP mm	STRAIN
75 Km/hr	1359.5	0.462389	0.004 82	426.16 4	0.437768	0.0025 74	347.02 6	0.4631 27	0.00541 99
150 Km/hr	2720.1	0.925276	0.009 65	851.73 7	0.875923	0.0051 51	693.92 8	0.9265 36	0.01084 66
300 Km/hr	5440.7	1.85143	0.019 53	1701.3	1.75299	0.0103 06	1386.7 1	1.8541 9	0.02170 825

CONCLUSION

In our project we have designed a frameless chassis used in a Volvo bus collecting data from Body construction workshop in Vijayawada.

Present used material for frameless chassis is Steel. We are replacing the steel with composite materials Carbon Epoxy and E – Glass Epoxy. By replacing with composites, the

weight of the frameless chassis is reduced by almost 4 times.

Impact analysis is done on the chassis at different speeds 75km/hr, 150 km/hr and 300 km/hr. By observing the results, the displacement and stress values are less for E – Glass epoxy than Steel and Carbon Epoxy.

We have also modified the design of frameless chassis by adding ribs at the top and bottom at the front side of the chassis. By observing the impact analysis on modified design the displacement and stress values are reduced than the present design.

So we can conclude that E – Glass epoxy is better material for frameless chassis and by modifying the design some advantages can be found (i.e) decrease of stress and displacement values.

BIBILOGRAPHY

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