ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Heavy vehicle chassis redesign in Ansys-13 with composite material

[1]RasickC Abdulla, [2]MuhammedFayizPK, [3]MuhammedShafeeq KK, [4]Loganathan S, [5]Prabhu L
Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Paiyanoor-603104, Tamil Nadu.
***Corresponding author: E-Mail: srilogu66@gmail.com**

ABSTRACT

The design of the bus body needs sufficient capability to perform under various types of loading and operating conditions besides those of the road conditions. Their structural strength, stability and crash worthiness are hardly evaluated, resulting in reduced passenger safety with increased possibility of damages. Hence the actual body thickness is changed and number of elements is also reduced to achieve weight loss of the bus body. Strength of the structure is determined by using three materials by carrying out Structural and dynamic analysis in Ansys-13.

KEY WORDS: Heavy vehicle chassis redesign, Composite material.

1. INTRODUCTION

The components of the basic structure (frame) which is the back bone of the vehicle are initially given the name Chassis actually a French term. A vehicle without body is called chassis. The vehicle transmission system, drive axles, road wheels, vibration dampers, brakes, steering system and electrical system are mounted on the frame. Body is also mounted on the frame. So Chassis is a carrying unit given the status as structure. Automotive chassis looks like a skeleton to which most of the parts like wheels and tyres, brakes, engine are bolted. The actual body components thickness is changed and number of elements is reduced for redesigning. The existing materials are replaced with composite materials. Both the material is utilized in the analysis by plotting the applied material properties. Composite material of carbon fiber is selected and subjected to analysis.

Witik: Weight reduction techniques are the combination of three types (i) Steel and iron material are replaced with alternative aluminum and composite materials. (ii) Optimized design via computer-based programs and optimization techniques to achieve higher performance and (iii) vehicle downsizing.

Giudice: The development method that introduced with usage of materials considering environmental aspects in the materials for components, meeting functional and performance requirements while minimizing ill effects associated with the product's entire life cycle.

Ermolaeva: Investigation of selection of material according to the potential mechanical behavior for a load and boundary conditions and optimal selection of material based on potential states that steel is the best candidate for heavily loaded structures.

Fitch and Cooper: The material evaluation for components is performed by life cycle energy analysis and product analysis for selection of material. The lowest life cycle energy consumption is achieved by glass fiber composite and high strength steel, Sustainability 2014, 6 4611. A study is conducted by the World Auto Steel Organization to investigate the effects of steel, aluminum, composite and AHSS on LCA under various combinations of bodies and power trains. In the study AHSS steel is found to be generating lesser damages in greenhouse gases than aluminum or mild steel.

Ungureanu: A methodology is developed to evaluate sustainability in order to compute the potential benefits of lighter materials like aluminum in body components. The study reveals that the current equipment and processes are well suited for steel based components and a complete redesign of this equipment and processes would be needed to manufacture aluminum components. International Iron and Steel Institute's Ultra-light Steel Auto Body (ULSAB) programme estimated the mass savings up to 25% by using dual-phase steel in a C-class (compact) car body structure.

Different Types Of Frames: The different types of frames are listed as under.

1. Conventional frame
2. Integral frame
3. Semi-integral frame

2. METHODS & MATERIALS

Composite Materials: Composite materials are prepared by combining two or more materials often having different properties. Unique properties are given out by working together two materials in composites. However, the different materials in the composite material do not dissolve or blend in to each other. Quality of life has been improved by the awareness in composite materials since several decades before Christ. Although it is not clear how Mankind understood to build long lasting houses made by mud bricks lined with straw. Ancient Pharaohs used bricks with straw to buildings so as to enhance the structural integrity; some of them testify the wisdom of the dead civilization even today.

As a result of innovation in the past few decades, contemporary composites found place in glass fiber automobile bodies and in particulate composites in aerospace components and a range other applications.

In spite of the growing popularity with composite materials in a range of applications, terms like "materials composed of two or more distinctly identifiable constituents" are employed to express natural composites timber and organic materials like tissue surrounding the skeletal system, soil aggregates, minerals and rock.

Composites are classified based on the scope that meets the needs of a specific function with desired properties.

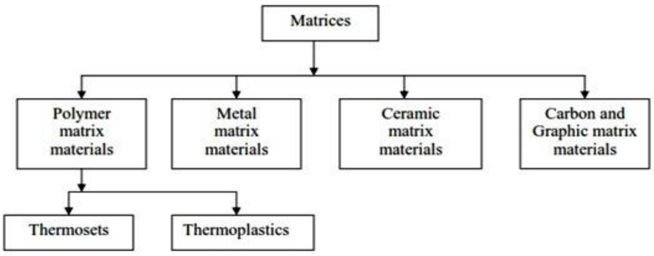

Figure.1. Block diagram

Properties

Material: Stainless Steel - Grade 304 (UNS S30400)

Composition: Fe/<.08C/17.5-20Cr/8-11Ni/<2Mn/<1Si/<.045P/<.03S

Table.1.

Property	Minimum Value (S.I.)	Maximum Value (S.I.)	Units (S.I.)	Minimum Value (Imp.)	Maximum Value (Imp.)	Units (Imp.)
Atomic Volume (average)	0.0069	0.0072	m^3/kmol	421.064	439.371	in^3/kmol
Density	7.85	8.06	Mg/m^3	490.06	503.17	lb/ft^3
Energy Content	89	108	MJ/kg	9642.14	11700.6	kcal/lb
Bulk Modulus	134	151	GPa	19.435	21.9007	10^6 psi
Compressive Strength	205	310	MPa	29.7327	44.9617	ksi
Ductility	0.3	0.57		0.3	0.57	NULL
Elastic Limit	205	310	MPa	29.7327	44.9617	ksi
Endurance Limit	175	260	MPa	25.3816	37.7098	ksi
Fracture Toughness	119	228	MPa.$m^{1/2}$	108.296	207.491	ksi.$in^{1/2}$
Hardness	1700	2100	MPa	246.564	304.579	ksi
Loss Coefficient	0.00095	0.0013		0.00095	0.0013	NULL
Modulus of Rupture	205	310	MPa	29.7327	44.9617	ksi
Poisson's Ratio	0.265	0.275		0.265	0.275	NULL
Shear Modulus	74	81	GPa	10.7328	11.7481	10^6 psi
Tensile Strength	510	620	MPa	73.9692	89.9234	ksi
Young's Modulus	190	203	GPa	27.5572	29.4426	10^6 psi
Glass Temperature			K			°F
Latent Heat of Fusion	260	285	kJ/kg	111.779	122.527	BTU/lb
Maximum Service Temperature	1023	1198	K	1381.73	1696.73	°F
Melting Point	1673	1723	K	2551.73	2641.73	°F
Minimum Service Temperature	0	0	K	-459.67	-459.67	°F
Specific Heat	490	530	J/kg.K	0.379191	0.410145	BTU/lb.F
Thermal Conductivity	14	17	W/m.K	26.2085	31.8246	BTU.ft/h.ft^2.F

Thermal Expansion	16	18	10^{-6}/K	28.8	32.4	10^{-6}/°F
Breakdown Potential			MV/m			V/mil
Dielectric Constant						NULL
Resistivity	65	77	10^{-8}ohm.m	65	77	10^{-8} ohm.m

Table.2. Standard fiber Properties

Descriptions	US Units	SI Units
Tensile Strength	600 ksi	4137 Mpa
Tensile Modulus	35 Msi	242 Gpa
Elongation	1.5%	
Density	0.065 lb/in^3	1.81 g/cc
Fiber Diameter	0.283 mils	7.2 microns
Carbon Content	95%	
Yield	400 ft/lb	270 m/kg

Table.3. Properties of Common Carbon Fiber Designs vs Metals

Material	Grade / Type	Design / Application	Longitudinal Tensile Strength (ksi)	Longitudinal Tensile Modulus (Msi)	Shear Modulus (Msi)	Density (g/cm^3)
Carbon Fiber/Epoxy (Unidirectional)	Standard Modulus	Bending	300	15	0.6	1.55
Carbon Fiber/Epoxy (Unidirectional)	Standard Modulus	Torsion	20	2.2	4.5	1.55
Carbon Fiber/Epoxy (Unidirectional)	Intermediate Modulus	Bending	325	20	0.6	1.57
Carbon Fiber/Epoxy (Unidirectional)	High Modulus	Bending	250	30	0.6	1.59
Steel	4130		100	30	12	7.7
Titanium	6M-4V		120	16	6.2	4.34
Aluminum	6061-T6		35	10	3.8	2.7

2. CONCLUSION

Art of representing the object or system is modeling. Complete representation of a structure with graphical and non-graphical information is defined as geometric modeling. Mathematical description of the geometry is generated and no geometry of a structure in the computer database and object images on the graphics screen. In the geometric modeling, the graphics object’s image is generated a graphics screen of the system by inputting three commands to the computer.

- The first type of command generates basic geometric entities like points, lines and circles
- The second type of command accomplishes the transformation of these graphics elements.
- The third type of command causes the various graphics elements joined into the desired shape through shape of the objects.

The user construct the input devices, the software then convert such a data into a mathematical representation, whichis stored in model database for later use. The model in the database can be subsequently called for analysis, modification or transfer.Thus the existing model is remodeled and analyzed to report the suitability of the composite material.

REFERENCES

Kim M.H and Suh M.W, Development of an optimum design technique for the bus window pillar, Proc, Instn. Mech . Engrs. Part 0, J. Automobile Engineering, 215(01), 2000, 11-20.

Lan F, Chen J and Un J, Comparative analysis for bus side structures and lightweight optimization. Proc. Instn. Mech . Engrs. Part D, J. Automobile engineer, 7(218), 2004, 1067-1075.

Lee M.M and Pine T, Automotive box section design under torsion. Part-l, nite element modeling strategy. Proc. Instn. Mech. Engrs. Part 0, J. Automobile Engineering, 214(05), 2000, 347-359.

Saito M, Development VF, Aluminum body for the most fuel efficient vehicle. JSAE Rev, 2000, 21,511·516.