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Design of Two Wheeler Electric Vehicle Ignitia V1.0

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Abstract

This study includes the virtual design of two wheeler electrical vehicle on CATIA V5 with consideration of advance comfort, trendy look, light weight and good mileage comparison with existing model. The study also includes the maximum weight loading analysis of the chassis material of EV IGNITIA V1.0 on Autodesk Inventor 2013 static force analysis

Keywords: CATIA V5 virtual design; Stress analysis; Ergonomics

Introduction

A IGNITIA V1.0 is a two wheeler electric vehicle having four basic unit and i.e. transmission system, suspensions, breaking and chassis.

Technical specification

Transmission: Hub derive

Motor type: Brushless 750W/48V

Dimensions: 1885×655×1040 mm, Wheelbase 1265 mm

Weight: 96 kg

Controller: Programmable CPU Top speed: 40 km/hr

Battery: Lithium Ion 4 pack (4×12) 48V Wheel: Aluminum

Braking system: Disk Brake

Suspensions: Hydraulic Dampers front and rear both

Tires: Nylon, 16 inch diameter front and rear

Design specification of ignition V 1.0

Note: We design this vehicle virtually so all the technical specification is theoretical.

The designing procedure has been completed on CATIA V5 with all standards of market and customized properties [1] of the vehicle (Figures 1 and 2).

Frame Analysis

The frame is made up of "*Mild Steel Grade S 303.*" The structure is normal struts type with uniform body structure. The joints are considered as welded with MIG welding process (Figure 3). The static load analysis is done on Autodesk Inventor Professional 2013 CAD Package [2,3] with boundary conditions only (Tables 1and 2). The

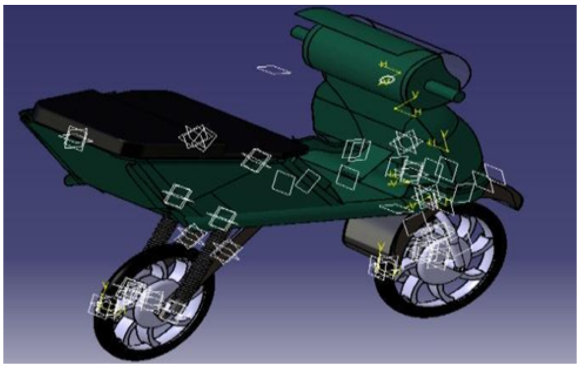

Figure 1: CATIA V5 design image of the two wheeler EV IGNITIA V1.0, side view [4].

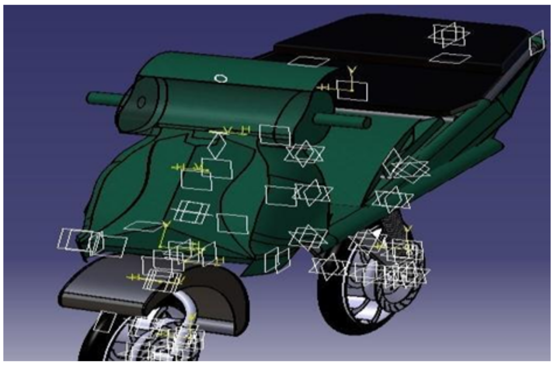

Figure 2: Catia Design Image of the two wheeler EV IGNITIA V1.0, front view.

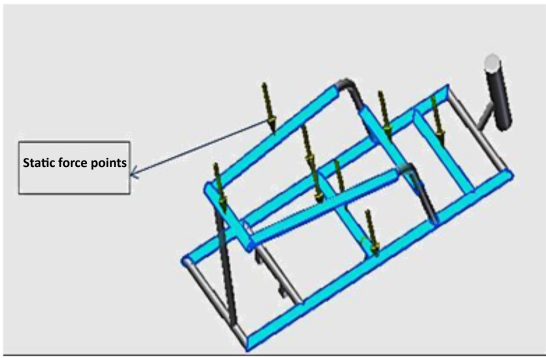

Figure 3: Frame with Static Force Points and constraint.

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Material	Steel, Mild
Density	7.86 g/cm^3
Mass	45.1746 kg
Area	718887 mm^2
Volume	5747400 mm^3
Center of Gravity	x=94.5993 mm y=-37.9994 mm z=0.494178 mm

Table 1: Frame Material Specification.

Design Objective	Single Point
Simulation Type	Static Analysis
Constraints	Fixed Type
Detect and Elimiate Rigid Body Modes	No

Table 2: Operation specification input data.

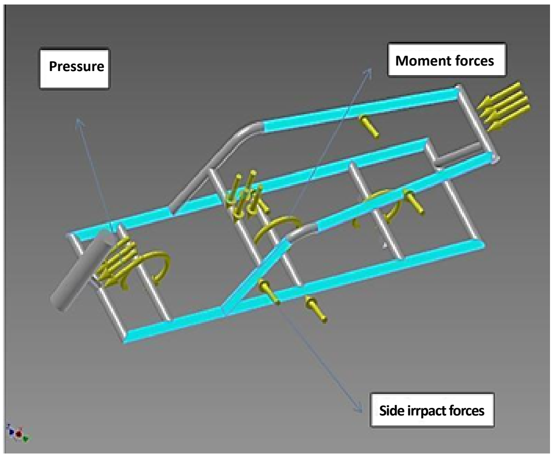

Figure 4: Frame with Pressure, Moment Forces and Side Impact Forces Points.

Avg. Element Size (fraction of model diameter)	0.1
Min. Element Size (fraction of avg. size)	0.2
Grading Factor	1.5
Max. Turn Angle	60 deg
Create Curved Mesh Elements	Yes

Table 3: Mesh element details [2,3].

testing completed on software was for minimum and maximum values of various loads and stress (Figure 4).

Considerations

The constraint included in this is fixed type constraint with max. Degree of Freedom is 3 and min. is zero. The load has been considered static on the vehicle with maximum loading condition. It includes the total weight of the vehicle including driver, co-driver, luggage and self-body weight. The initial torque is also considered as rotational moment on fixed constraints [4] of chassis and wheel.

Meshing

Tetrahedralmesh [5] is considered for the analysis of frame. Average element size (fraction of model diameter) is 0.1, minimum element size (fraction of average element size) is 0.2, grading factor is 1.5, and max. Turn angle is 60 degree (Tables 3 and 4). Total numbers of nodes are 21323 and elements are 11652 as shown in (Figures 5-7). This stage of part design gives accuracy of more than 99.5 % regarding efficiency of it. These meshes are generated accordingly to the forces, loads and moments applied (Table 5). These are the nodal points which give exact figure of stress analysis, factor of safety and fatigue analysis of the materials.

Name	**Steel, Mild**	
General	Mass Density	7.86 g/cm^3
	Yield Strength	207 MPa
	Ultimate Tensile Strength	345 MPa
Stress	Young's Modulus	220 GPa
	Poisson's Ratio	0.275 ul
	Shear Modulus	86.2745 GPa
Stress Thermal	Expansion Coefficient	0.000012 ul/c
	Thermal Conductivity	56 W/(m K)
	Specific Heat	460 J/(kg c)
Part Name(s)	Chassis Ignitia	

Table 4: Material specifications [5].

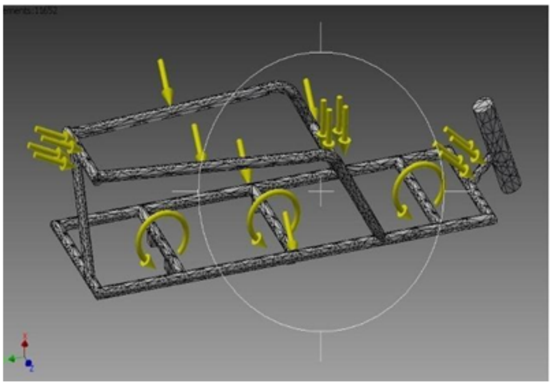

Figure 5: Tetrahedral Mesh frame.

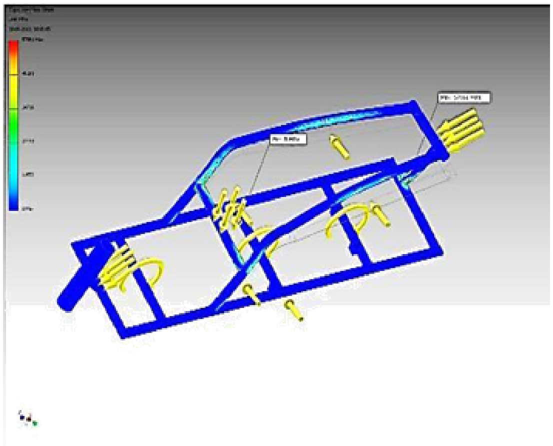

Figure 6: Von Miss Stress results.

Simulation Data

After running the program the following value tables are generated from the Autodesk inventor software which exactly gives us the value of maximum load and minimum load criteria for our design and ideal vehicle specification (Table 6).

Results

According to the interpretation of the table values color histograms

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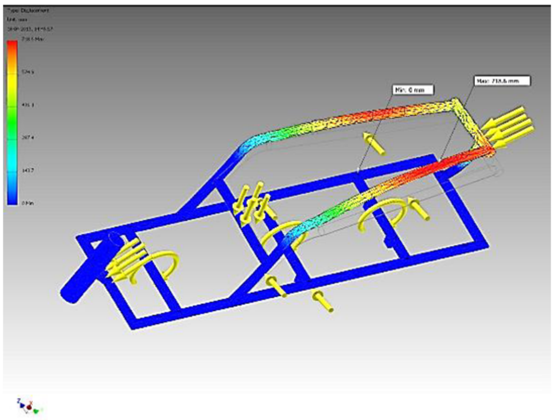

Figure 7: Maximum Displacements Results.

Load Type	Force
Magnitude	5004770.0320 N
Vector X	-2028050.391 N
Vector Y	533606.915 N
Vector Z	4538972.931 N

Table 5: Operation condition, data of force applied [2].

Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)
Fixed Constarint: 1	5149410 N	2425230 N	553081 N m	-327348 N m
		232254 N		427017 N m
		-4536600 N		-128056 N m
Fixed Constraints	1.89081 N	1.8615 N	0.224292 N m	0.0945 N m
		-240465 N		-0.042 N m
		0.228388 N		-0.198 N m

Table 6: Reaction Force and Moment on Constraint [4,5].

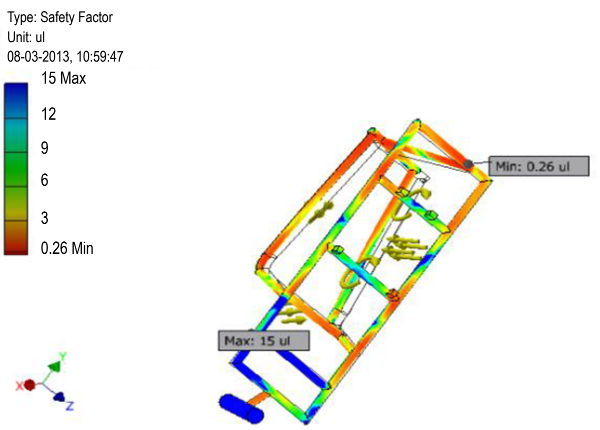

Figure 8: Safety Factor results.

has been generated. The value of histogram varied from max. to min. with their color contrast (Table 7). According to the values factor of safety obtained is 3 and max as shown in Figure 8.

Conclusions

The interpretation of the results is positive for the desire criteria.

Name	Minimum	Maximum
Volume	5737800 mm^3	
Mass	45.0991 kg	
Von Mises Stress	0.000000000565748 MPa	57860.8 MPa
1st Principal Stress	-9292.06 MPa	63994.3 MPa
3rd Principal Stress	-44605.1 MPa	15330.1 MPa
Displacement	0 mm	12.455mm
Safety Factor	0.00357755 ul	15 ul
Stress XX	-43676.4 MPa	57996.3 MPa
Stress XY	-15319.3 MPa	18173.9 MPa
Stress XZ	-17665.8 MPa	22247.2 MPa
Stress YY	-20745 MPa	24785.7 MPa
Stress YZ	-6356.96 MPa	10868.7 MPa
Stress ZZ	-33439 MPa	32974.4 MPa
X Displacement	-228.29 mm	428.397 mm
Y Displacement	-143.982 mm	54.5902 mm
Z Displacement	-3.19758 mm	673.259 mm
Equivalent Strain	0.00000000000000257516 ul	0.235432 µl
1st Principal Strain	-0.000482355 µl	0.275154 µl
3rd Principal Strain	-0.200584 µl	0.0000000218705 µl
Strain XX	-0.187881 µl	0.240393 µl
Strain XY	-0.0887824 µl	0.105326 µl
Strain XZ	-0.102382 µl	0.128933 µl
Strain YY	-0.092741 µl	0.0951339 µl
Strain YZ	-0.0368415 µl	0.0629889 µl
Strain ZZ	-0.14451 µl	0.143729 µl

Table 7: Summarized simulation results [3-5].

According to the given load conditions the frame is safe. The frame is under maximum load and it's obtained the desire factor of safety. The simulation tables are having the desired range of deformation and displacement values. The frame is required no modifications further and safe enough for all kind of given loads.

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