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Design and Fabrication of Electricmotor Bike Frame

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ABSTRACT

The main aim of this review paper is to present the idea of harnessing various types of energy and use it in today's existence of human life. For human being travelling has become vital. In order to sustain in this fast forward world, must travel from place to place. It is very important that time taking for travelling should be less; also, it should be economical and easily available. Chassis or Frame is the most dominant and crucial part of an automobile. It is subjected to various stresses, strains, impact loads and vibrations during the motion, which could affect the bike frame, its components and mainly discomfortness to the rider. Our intension is to manufacture a bike frame that could be resistive to all sorts of complications and efficient in its applications. The material used, joints aligned, angles taken into account, which could help the frame to withstand in almost all cases of applications. As we know that a frame acts as a skeleton to the automobile, we decided to design our frame in such a way that it could resist all the forces acting on it. In order to achieve this we worked mostly with the solidworks for the design followed by the analysis. In the beginning of the fabrication process, we discussed particularly about the selection of the material of the pipes, which we are going to use in the fabrication of the frame. Therefore, when we realised that the low carbon steel is fulfilling all our requirements, we decided to use the carbon steel pipe. From here, our manufacturing process began. At first, cutting the pipes as per the design data and after that, welding is done at the joints to make assembly. With the help portable grinding machine, sharp or unprocessed edges of welded areas are machined. Finally, to avoid the corrosion, bike frame coated with lead oxide.

Keywords: Frame, Low Carbon Steel, Electric Arc Welding, Solid Works, Analysis

I. INTRODUCTION

A motorcycle frame is a motorcycle's core structure. It supports the motor, provides the hinge points for both front and rear suspension, and supports the rider and any pillion or luggage. Also attached to the frame are the controller and battery. At the front of the frame the head tube that holds the pivoting front fork, while at the rear there is a pivot point for the swing arm.

Frame is the backbone of the vehicle, which gives scope to incorporate the various components and mechanisms. The bike frame can be made with various materials like alloy steels, Aluminium, titanium alloys etc.

Due to the various considerations like strength, Toughness and Carbon content we had manufacture this frame with low carbon steel.

As per the following properties of Low carbon steel, we choose this material:

1. The carbon content of the low carbon steel ranges from 0.05 to 0.320 %.
2. As due to the low carbon content this material gives the tendency of strength,

Toughness, Ductile, best weld ability, Formability, good wear résistance.

3. It is the most cost effective form.

The early history of electric motorcycles is somewhat unclear. On 19 September 1895, Ogden Bolton Jr. of Canton Ohio filed a patent application for an “electrical bicycle”. On 8 November of the same year, another patent application for an "electric bicycle" was filed by Hosea W. Libbey of Boston.

1.1 Types of Motorcycle Frames

The basic function of a motorcycle frame is somewhat similar to that of the skeleton in the human body, i.e., to hold together the different parts in one rigid structure. One of the major benefits (for a motorcycle enthusiast) of using an advanced frame design lies in the sporty handling characteristics of the bike. A well-designed frame can add to the joy of riding a motorcycle as the bike would feel more stable, effortless, and confident around corners, in straight lines and while braking. As per our requirement, we took “cradle frame” as the reference for the design and fabrication of our electric motor bike frame.

- ✓ Backbone frame
- ✓ Diamond frame
- ✓ Cradle frame
- ✓ Trellis frame
- ✓ Perimeter frame
- ✓ Monocoque frame

Cradle Frame

Cradle frames are another one of those very common types of frames found on Indian bikes. Along with the backbone/top tube + down tube(s) these frames also have tubes which run down the engine. It’s like cradling/supporting the engine. Unlike a diamond frame, the engine is NOT a “stressed” part of the frame on this frame.

Figure 1

List of Indian bikes with Cradle frames are:
Bajaj: Platina100, Discover 100/125/150, Pulsar 150/180/220, Avenger 220
Hero: CD Dawn/Deluxe, Splendor, Splendor NXG, Passion, Super Splendor, Glamour
Honda ☹ None)
Suzuki: (None)
TVS: Apache RTR 160/180
Yamaha: Crux, YBR110

II. DESIGN AND ANALYSIS OF MOTORCYCLE FRAME WITH SOLID WOKS DESIGN TOOL

2.1 Design of Frame Using Solid works

Design is the creation of a plan or convention for the construction of an object, system or measurable human interaction as in architectural blue prints, engineering drawing, business process, circuit diagrams, and sewing patterns.

Design has different connotations in different fields. In some cases, the direct construction of an object as in pottery, engineering, management, coding and graphic design is also considered.

Designing often necessitates considering the aesthetic, functional, economic and socio-political dimensions of both the design object and design process. It may involve considerable research, thought, modelling, interactive adjustment and re-design. Meanwhile, diverse kinds of objects should designed, including graphical user interfaces, skyscrapers, corporate identities, business process. In

order to design the frame we used solid works software.

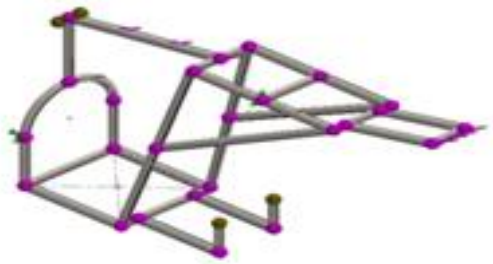

Figure 2.1. Design of frame and selecting various joints during analysis

Table 1. Motorcycle Frame Study Properties

STUDY NAME	STUDY 2
ANALYSIS TYPE	STATIC
MESH TYPE	BEAM MESH
SOLVER TYPE	DIRECT SPARSE SOLVER
INPLANE EFFECT	OFF
SOFT SPRING	OFF
INERTIAL RELIEF	OFF
INCOMPATIBLE BONDING OPTIONS	AUTOMATIC
LARGE DISPLACEMENT	OFF
COMPUTE FREE BODY FORCES	ON
RESULT FOLDER	Solid Works document (C:\Users\windows\Desktop)

Table 2.2. Mesh details of motorcycle frame

MESH GENERATION

MESH TYPE	BEAM MESH
TOTAL NODES	437
TOTAL ELEMENTS	401
TIME TO COMPLETE MESH	00:00:05
COMPUTER NAME	HP

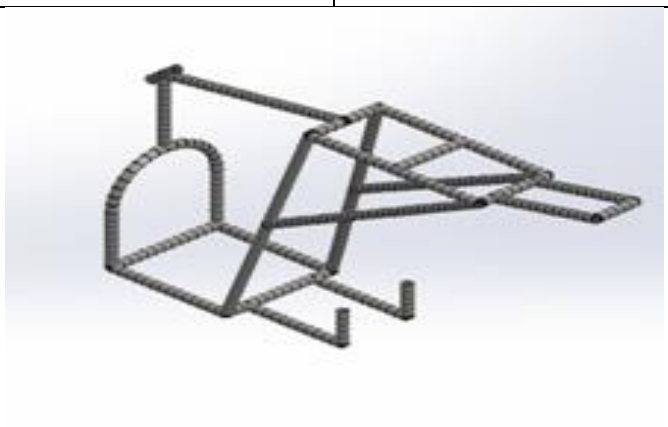

Figure 2.2. Mesh model of motorcycle frame

III. FABRICATION OF MOTORCYCLE FRAME

This project contains two phases, in first phase modeling and design of motorcycle frame using solid works and conducting analysis using solid works. At second phase, based on the obtained analysis results frame is fabricated. This chapter will be dealing with the pre-cautive methods to avoid the most common mistakes, and a few uncommon mistakes. The typical weld fabrication steps are:

- ✓ Get or make a fabrication sketch or drawing.
- ✓ Develop a well thought out step-by-step procedure.
- ✓ Gather tools and materials.
- ✓ Make patterns, jigs, templates and fixtures, if needed.
- ✓ Put together a cut list.
- ✓ Lay out and cut the materials.
- ✓ Make edge preparations and clean the metal areas to be welded.
- ✓ Position of the material done.

- ✓ Tack welds assemblies, check dimensions, setup and squareness.
- ✓ Place the final welds and assemble the final fabrication.
- ✓ Grind welds smooth only if necessary.
- ✓ Paint the fabrication, if needed.

Figure 3.1. Fabrication of motorcycle frame

FRAME SPECIFICATIONS

- PIPE MATERIAL : LOW CARBON STEEL
- FRAME TYPE : CRADLE FRAME
- WELDING : ELECTRIC ARC WELDING

IV. RESULTS AND DISCUSSIONS

Motorcycle frame was analysed under the conditions for generation of stress, static displacement at critical locations. The static analysis performed using solid works design tool.

Table 4.1. Reaction Forces Results

SELECTION SET	UNITS	SUM X	SUM Y	SUM Z	RESULTANT
ENTIRE MODEL	N	87.6841	54.0376	-1.2919	103.006

The Total resultant reaction force is: 103 Newton

Table 4.2. Reaction Moments Results

SELECTION SET	UNITS	SUM	SUM Y	SUM Z	RESULTANT
ENTIRE MODEL	N-M	0.19318	0.0160	1.6019	1.6136

The Total resultant reaction Moment is: 1.6136 Newton meters

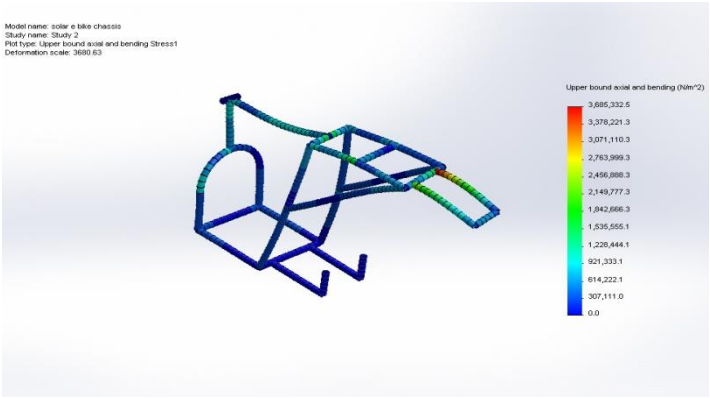

Figure4.1. Motorcycle frame under upper bound axial and bending stress

Table 4.3. Upper bound axial and bending stress table

NAME	TYPE	MIN	MAX
STRESS1	TXY: SHEAR IN Y DIR. ON YZ PLANE	0 N/M^2 ELEMENT: 379	3.68533E+006 N/M^2 ELEMENT: 47

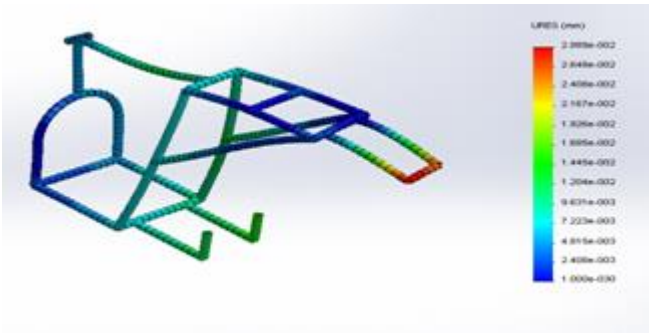

Figure 4.2 .Motorcycle frame under static displacement

Table 4.4. Resultant static displacement

NAME	TYPE	MIN	MAX
DISPLACEMENT 1	URES: RESULTANT DISPLACEMENT	0MM NODE : 121	0.0288921 MM NODE: 321

V. CONCLUSION

By this study we conclude with various analysis tests theoretically as well as experimentally that our low carbon steel bike frame can with stand a load up to 2059.396N without deflection and the material can be shock resistant and it can support two to three persons riding without fail. This design will support smooth riding and absorb fewer amounts of vibrations and sudden impacts. The total number of elements involved in our electric motorbike frame are “401”, and the type of mesh chosen for the simulation or analysis of the frame is a “BEAM MESH”. The total number of nodes of our bike frame are “437”. So finally after proper analysis of our bike frame we can conclude that the total resultant reaction force is 103 newtons and the total moment is 1.6136 newton meters. The frame is also designed and fabricated in such a way that it can be even modified as per our requirement to meet the future needs.

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