Ergonomics of a Custom Made Solar Electric Car

Karam Siva Bhushan Reddy, M. Vijaya Kini, Amol Grover, and P. S. Sujay

***Abstract*—A 1:1 Ergonomic apparatus was designed and fabricated for a solar electric passenger car in compliance with the regulations prescribed in the document 'World Solar Challenge - Rules and Regulations 2013' and the road rules of the country. The apparatus has adjustable cabin dimensions to incorporate various body dimensions that are required for a passenger car. Several ergonomic parameters were used to obtain an optimum design. Importance was given to safety, human machine interface and comfort. The Ergonomics features were designed, analyzed and validated using the solid modeling software CATIA to make a prototype to incorporate the people within the range of 95 percentile male to 5 percentile female.**

***Index Terms*—Cabin, ergonomics, solar car, world solar challenge (WSC), catia.**

I. Introduction

Ergonomics is an aspect which is crucial in any car and hence requires utmost attention. It is an interface where human and machine interacts. It is important to note that vehicle packaging is meant to provide suitable space for people and parts of the vehicle; human factor consideration is a must for the integration of the total design [1]. The cockpit informs the driver of the vehicle's condition and executes the driver's commands [2].One should also make sure that the interior equipment doesn't distract the driver's attention [3] while driving and are situated in places that will not damage the passengers in case of an accident. Driver comfort and accessibility of vehicle controls during car operation maximizes the performance capabilities of the car [4], [5].

This study attempts to design a cabin that can accommodate a range of drivers within the stipulated rules and regulations being safety and comfort outmost priority. The important dimensions in the ergonomic apparatus are the seat rest angle, the seat base angle, the steering location, the brake pedal location and the position of the hip point. The ergonomic apparatus was designed and built keeping each of the above dimensions adjustable. Data for all these parameters was compiled and analyzed to obtain the optimum angles and position of seat, steering, brake pedal and accelerator pedal location.

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II. Methodology

Several models of commercial cars were studied for their ergonomic features. An extensive ergonomic research was done in order to obtain cabin dimensions for a passenger vehicle under WSC-Rules and Regulations 2013 along with road rules of the country. Ergonomics and Analysis, Human Builder and Human posture modules of CATIA were used to obtain a preliminary design of the seat and driver's posture. Human builder was used to determine the viewability of the driver, height of the car and also for fixing the position of steering assembly (see Fig .1).

Fig. 1. Ergonomic setup designed in CATIA.

The angles and position were limited over a certain range, keeping safety and comfort in mind. Initial design was converted to a 1:1 prototype using ply wood. Wood was considered as it was easily available, affordable and easy to work with. Steel racks were used to provide a rigid frame to get a basic idea about the car's body. The average height was considered to be 5' 11" or 95th percentile male as per WSC regulations.

Following objectives were set for the optimum performance:

1) Seat back rest Angle
- Driver remains at a comfortable position
- Centre of gravity remains as low as possible
- Proper view and accessibility

2) Seat Base Angle
- To provide thigh support while operating pedals
- To provide proper access to brake pedals

3) Steering Location
- To provide proper grip to the driver
- Driver can turn the steering wheel without much strain in hands.

4) Proper width of the cabin to accommodate seat and driver.
5) Proper positioning of pedal assembly and steering wheel

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