

ERGONOMICS & SAFETY REPORT

INTRODUCTION:

Ergonomics and Safety is a very important factor when it comes to a complete commercial vehicle. Ergonomics refer to the design factors, as for the workplace, intended to maximize productivity by minimizing operator fatigue and discomfort. Safety of the driver in any situation must also be ensured. Ways of unsafety was studied and the vehicle is properly designed to give additional safety and comfort.

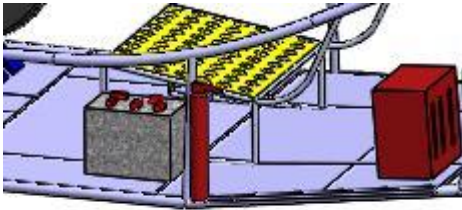
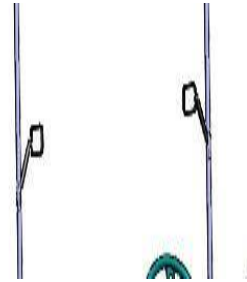
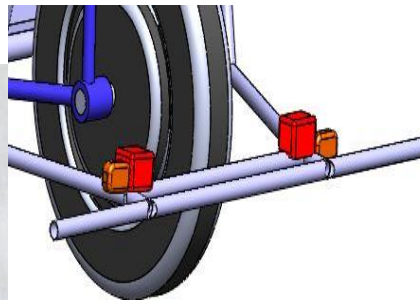
ERGONOMIC FEATURES:

1. Safety features
2. Centre of gravity
3. Placement of battery
4. Placement of Solar panel
5. Aero-dynamics

DESCRIPTION:

1. Safety Features:

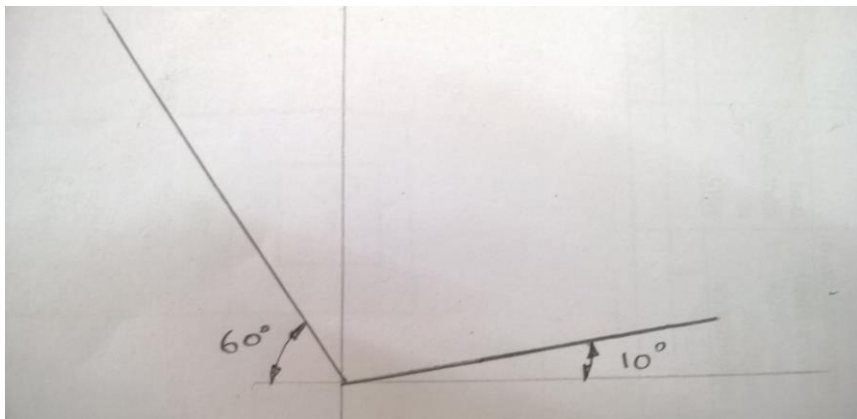
1. The driver is provided a proper driving kit consisting of *Helmet, gloves, Shoes and Jacket*.
2. The *seat belt* is provided to prevent driver from slipping from the seat.
3. In case of fire a *2kg extinguisher* is fitted in hands reach
4. *2 bright rear brake & steering lights* to signal other drivers
5. *NYLON Lock nuts* is provided to every bolt to prevent loosening
6. *2 kill switches* that cuts of the power line from battery to motor and panel to battery connection is placed one for driver's reach in the switch controls near him and one for other's reach from outside on the rear suspension clamp.
7. Wires pass through *0.25inch PVC* insulation tubes. It prevents contact with steel frame and water proof it ensuring there is no leakage
8. Main electrical components such as battery and circuits are properly ventilated and contained in a insulator material
9. Average **FOS** of the vehicle is maintained around **2**.



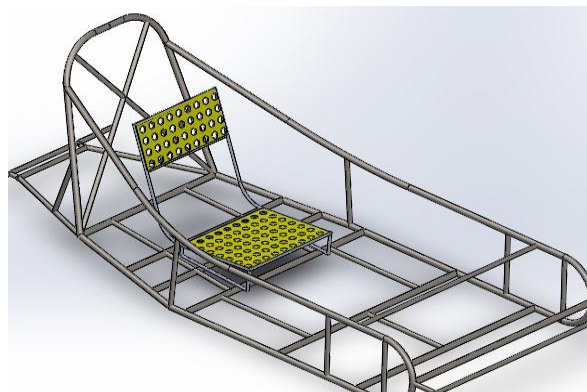
2. Egress Time:

Egress time depends on position of the driver.

Driver's comfort depends on the position he sits. A good position can make a driver go long drives without any fatigue and stress and enjoy the drive. The below position



Seat must provide comfort and shouldn't allow driver to slip in turns. To conserve weight and also good comfort for the driver, seat's frame comes along attached to the frame with woven plastic strings to it



With retractable steering and good space driver can get out of the cart well within 5seconds.

3. Placement of Battery:

No of battery = 4

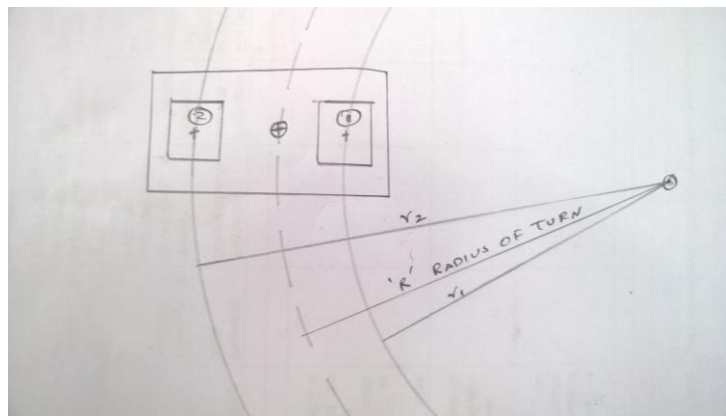
Weight of each battery = 7kg

Total weight = 28kg

Weight is distributed to determine CG point of the vehicle. All the weights of components are placed to concentrate exactly in the CG point (Detailed in Centre of gravity).

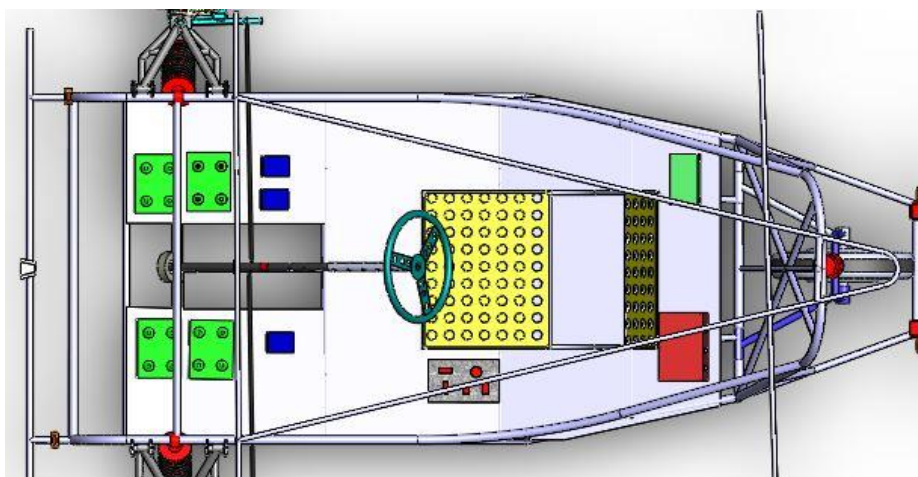
If the weights must also lie close as possible to the CG point so that *vehicle spin* with respect to vertical axis is eased which gives additional advantage while steering by overcoming under steering.

The below representation shows the concept of weight distribution affecting handling



The outward placed mass 2 will contribute more moment than the inner one because of increased radius. When placing it too away from centre makes it a disadvantage while steering and when placing in on the centre will help in more spin of the vehicle. So the batteries are placed to balance out both these effects.

In order to minimise the understeering the batteries are closed in near front. Space for driver must also be considered. The final placement of batteries is represented in the below image

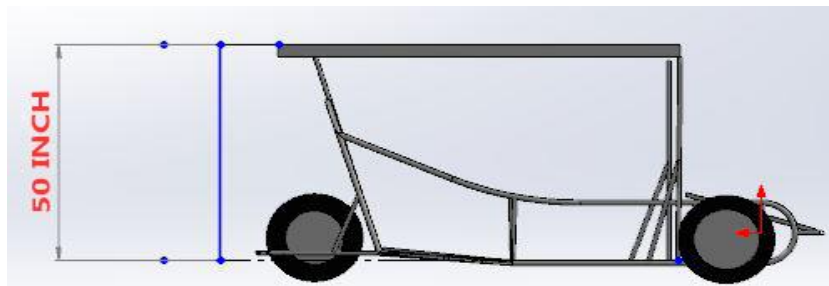


The green boxes are the Batteries. They are placed in front of the vehicle to bring the CG towards front.

4. Placement of Panels:

Totally 4 panels are used. Totally 50squarefeet of panels are used. Panels are placed with the following consideration

1. Maximum sunlight reception
2. Aerodynamics of the vehicle
3. Convenience for the driver



Isometric View

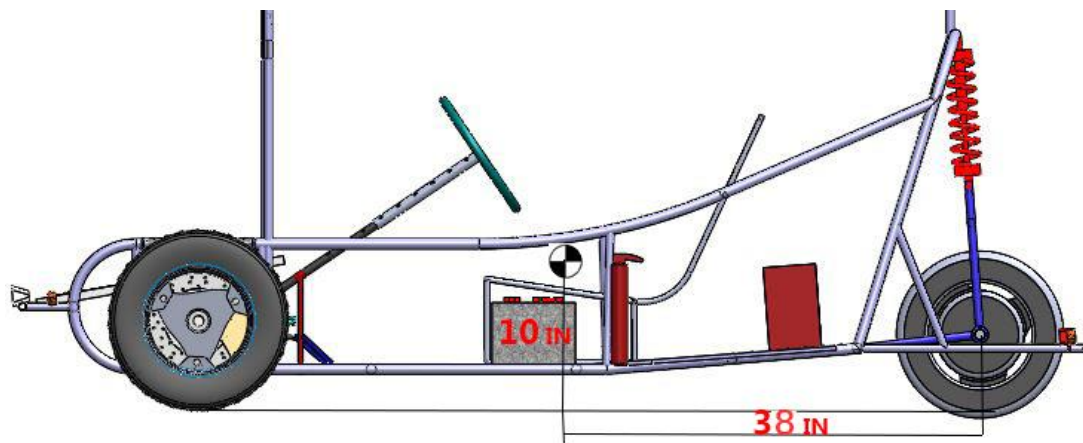
Panel – Aerodynamic attachments

5. Centre of Gravity

It is one of the most important parameter for vehicle balance. Centre of gravity also known as centre of mass is the resultant mass of all components acts.

The weight distribution is the ratio of the horizontal weight displaced between the forward and aft wheels. It dictates how a trike handles and how stable it will be. The more weight on the forward wheels, the better the cornering and less over-steer. However, too much weight on the front wheel causes the rear wheel to be too light. This can lead to rear wheel wash-out during hard cornering or cause the trike to end-over during braking. Too much weight on the rear of the trike causes it to capsize even during mild handling as the single wheel has the majority of weight. A trike with 60/40-weight distribution is optimum.

Batteries, Solar panels and driver weights symmetrically major weight components are distributed to bring the CG point exactly on the vertical axis. Placing CG nearer to ends can cause flipping in heavy breaking and unbalance while taking turns. So the CG is placed 60% of the total length from the rear bumper.



For a more stable design the CG point must be as low as possible, so that CG shift will be contained within the base of the vehicle which decreases possibility of flipping over.

6. Aerodynamic:

Aerodynamics is the study of flow of air. Most of the energy is lost to air resistant.

Aerodynamics is a secondary parameter in designing 60km/hr. If aerodynamic designs are used under the critical speed the effect of lift will create more air resistance which gives more load for the motor to overcome. So the design is created to reduce air resistance and ease the flow of air through the vehicle

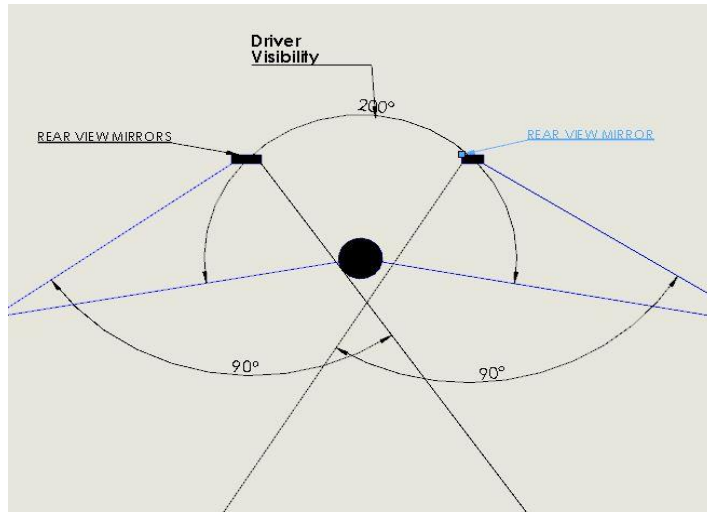
Aerodynamic techniques used:

1. Mounting top panels horizontally
2. Front panel is inclined so as to deflect air away than flowing inside components.
3. Providing curved caps at front of panel and a rigid tail at the end to ease air flow

The cart is designed to ease air flow through than over the vehicle.

7. Driver Visibility

Driver's visibility is restored to 220°. Additionally 2 1 rear-view mirror is provided to see the other 140° is provided to 2 rear view mirrors on either sides. Driver will have a clear visibility of 360°.



CONCLUSION:

Every factor has been taken into account in designing the vehicle. Safety of driver and costly components under normal city driving is ensured. Ergonomics of vehicle has been well defined in all aspects contributing improvement in vehicle dynamics, handling, comfort and efficiency of the vehicle and driver.