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# Introduction, Designing, Simulation and Fabrication of Horseshoe Type Steering Mechanism

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**ABSTRACT:**
In modern era, vehicle stability and handling have become the major aspect without any compromise in steerability and handling of vehicle, with keeping in mind the driver's safety and comfort. Our main intention is to design, fabricate and simulation testing of light weight, highly sensitive, less complex and economic steering mechanism. Since a solar powered vehicle for Electric Solar Vehicle Championship, weight factor is the main concern and we have to reduce it as much as possible. So we have done a real world designing of horseshoe type steering mechanism after its virtual solid modeling and simulation testing using CAD and CAE software respectively.

## I. Introduction:

Steering creates interface between the driver and vehicle it helps to control the vehicles direction by steering the wheels or we can say that the act of guiding vehicle is done by steering system.

In modern techniques, front wheel steering and the four wheel steering is used for the directional motion to control the vehicle.

The steering system may or may not be consists of several links and gears. Steering system must be precise because more precise it is, more will be the stability. There are several things which affects the stability of the vehicle are Camber, Caster, Toy-in, Toy-out. Caster angle is used for the reversibility of steering wheel, positive camber angle is used in heavy vehicle and negative camber angle is used in racing vehicles which helps in turning. There are so many types of steering geometries for perfect steering such as Devi's and Ackermann steering geometry. In Devi's steering geometry the major problem is that the inner wheel steers equal to the outer wheel which increases the turning radius and decreases the stability. In Ackermann steering geometry the inner wheel turns more than the outer wheel but gives very poor Ackermann percentage for the gear ratio of 1:1 in front wheel steering so we have used the horseshoe plate type steering mechanism instead of other steering systems to increase the stability at the same gear ratio.

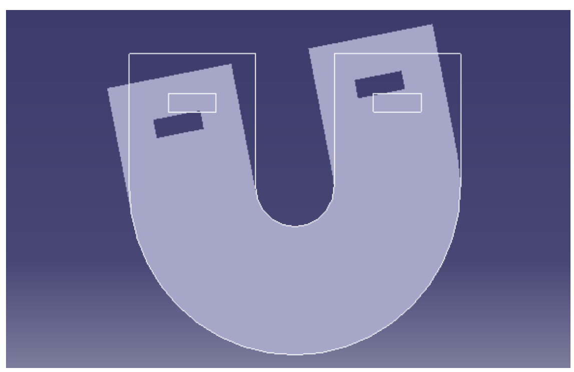
## II. Description:

As we see the problem of vehicle stability and lower Ackermann percentage horse shoe plate steering gives the better stability without tilting the knuckle arm.

In horseshoe type steering initially the tie rods were at the inner wall of horseshoe plate in the rectangular section. When we turn the vehicle left the left hand side tie rod were directly forced but the right hand side tie rod will move some distance of 11.22mm from the inner wall to the outer wall of right hand side rectangular section after that the forces will act on it and it will move the wheel assembly.

But the chances for the failure of horseshoe plate will be maximum when the vehicle is in dynamic condition so we have worked on it and got to know that the most sophisticated area of horseshoe steering is tearing of plate. Hence we restrict our consideration, Broaden our scope to the tearing part only and do calculation for the thickness of horseshoe plate.

Fig1. Horseshoe plate and tie rod assembly



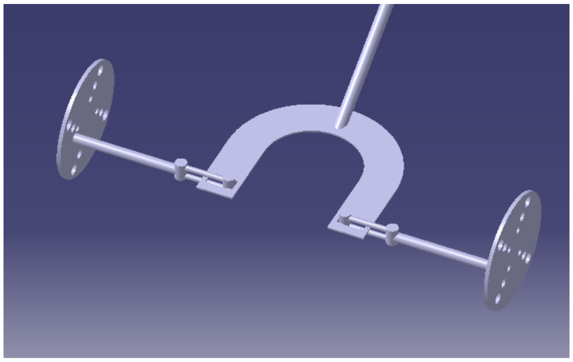


Fig.2. Rotation of horseshoe plate about fixed axis

D =Hole Diameter
P =Pitch length
б$_t$= Allowable tensile stress of material
$A_t$=Tearing Area of plate
T =Thickness of plate
$P_t$=permissible tearing resistance of material
On Assuming Maximum force act on the horseshoe plate in dynamic condition= 490 N

D=7mm
Pitch,
P=1.5D
P=1.5*7=10.5mm
T= $A_t$/(P-D) = 7*10.5/(10.5-7) = 21mm
$P_t$= $A_t$ *б$_t$ = 73.5*550 = 40425 N/mm$^2$
This is very high, so we have to reduce the thickness, 490(maximum force in dynamic condition) < 40425 (Maximum permissible tearing resistance)

On assuming the tearing resistance will be 7000N
$A_t$=12.72
T=12.72/(7-1.5) = 2.31mm
**T=2.31mm**

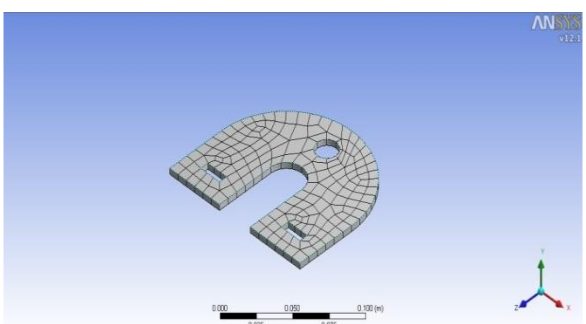


Fig.3 Meshed Modal of Horseshoe plate

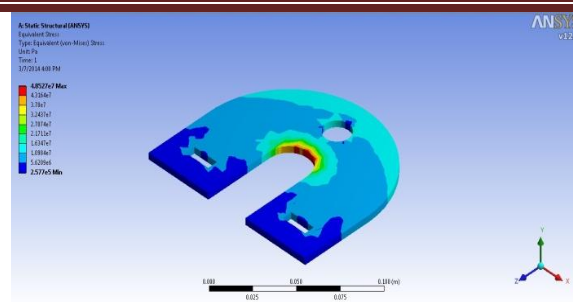


Fig.4 Von-Mises Stress diagram

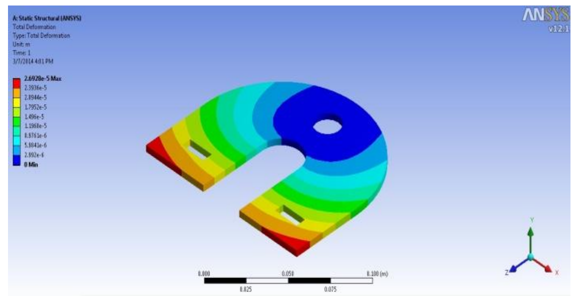


Fig.5 Deformation under Extreme Condition(0.026)

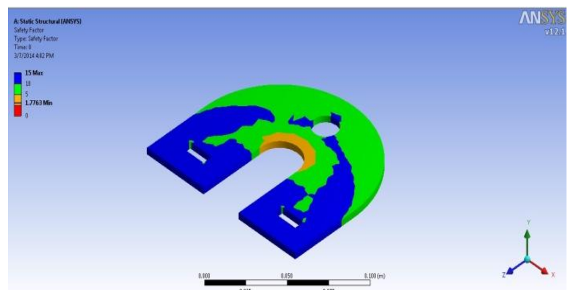


Fig.6 Fatigue Safety Factor

## III. Conclusion:

Due to the working on horseshoe plate type steering system we got to know about its vital components, effective and essential modes of failure, and the overcoming of those failures. We have designed and fabricated the steering system with better Ackermann percentage, stability and which economic too. It reduces the turning radius without tilting the knuckle arm as not seen in the conventional type steering mechanism. It is very sensitive and reduces the driver's effort on steering wheel. To minimize the risk of failure of horseshoe plate, considerable amount of Factor of Safety is kept which makes it safe even on high applied loads and deformation.

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