

Design and Fabrication of Zero Degree Turn Four Wheel Steering System

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Abstract— Nowadays every vehicle existed mostly using the two wheels steering to control the movement of the vehicle. We are designing the four wheel steering system named as “Quadra Steering System.” In this system one half of the vehicle will rotate in same direction while the other half of the vehicle wheel rotate in opposite to this side .in order to achieve this a mechanism which consist of two bevel gear an intermediate shaft which transmit 100% torque and turn rear wheel was developed. The mechanism was modeled using Catia. This result in more stability, less body leaning and easy parking at traffic places.

Key words: Fabrication of Zero Degree Turn Four Wheel Steering System, Zero Degree Turn Four Wheel Steering System

I. INTRODUCTION

Zero turn vehicle as the name itself indicates the meaning that a vehicle take the turn with zero turning radius and gives circular path without leaving its circular axis passing through the centre. Zero degree turning radius vehicle implies the vehicle rotating about an axis passing through the centre of gravity of vehicle. No extra space is required to turn the vehicle. So vehicle can be turned in the space equal to the length of the vehicle itself. Four wheel steering system can be employed in some vehicle to increase their steering response and as well as increase vehicle stability when moving at specific speed or to decrease turning radius at low speed. Nowadays most of the vehicles used two wheel steering system as their main steering system. But two wheel steering system has low efficiency as compared to the four wheel steering system. It gives high inertia therefore there is need of mechanism results in less turning radius. This can be achieve by four wheel steering system instead of conventional system.

A. Purpose of Steering System

The purpose of steering system is to allow the driver to control the direction of vehicle by controlling the front wheel. The steering system consists of following parts

- Steering wheels handles the steering operation.
- Steering columns join the steering wheels and gears
- Steering columns join the steering wheels and the steering gears.
- Steering gears converts the steering torque and rotational deflection from the steering wheel, transmit them to the wheel through the steering linkage, and make the vehicle turn.

B. Function of Steering System

- To control the direction of motion of the vehicle.
- To give directional stability for vehicle while going straight.
- To reduce tire wear.

C. Steering Requirements

- The steering should be very precise and easy to handle
- Excellent mobility when the vehicle is cornering on a narrow twisting road, the steering system must be able to turn the front wheel sharply easily and smoothly.
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- Vehicle should have the tendency to return to its original position after turning.

II. DESIGN AND WORKING OF 4 WHEEL STEERING SYSTEM

There is one thing which is to be remembered that both the steering wheels turns in opposite direction. Since the inner wheel travel by a larger distance as compare to outer wheel. This mechanism works on Ackerman’s principle.

A. Ackerman’s Steering Mechanism

Ackerman steering geometry is a geometric arrangement of linkages in the steering of a car or other vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radii. The steering pivot points are joined by a rigid bar which is called as a tie rod that is also a part of the steering mechanism. With perfect Ackermann, at any angle of steering, the centre point of all the circles traced by every wheel which will lie at common point.

As we know that modern cars don’t use pure Ackermann steering because it ignores the important dynamics and complete affects but the principle is sound for low speed maneuvers right and left wheels turn by different angles be it any cornering speed, we can choose to use a simple control circuit to demonstrate the effectiveness of a four wheel steering system.

The Design calculation for model follows.

1) Condition for True Rolling Motion

When all four wheels are rolling perfectly for add dynamic conditions then perfect steering of wheels can be archived , while taking a turn the condition of perfect rolling motion will be satisfied if all the four wheel axes when projected at one point, called the instantaneous centre when the following equation is satisfied.

$$\cot\phi - \cot\theta = c/b \text{ —————(1)}$$

We know that the inside wheel is required to turn through a greater angle than the outer wheels. The larger steering angle, smaller will be the turning circle. It had been found that the steering angle can have maximum value of about 44° under dynamic condition .The diameter smallest circle which the outer front wheel of car can travels and obtain when the wheels are at their extreme position is known as turning circle.

B. Davis Steering Mechanism

The Davis gear mechanism consists of a cross link KL sliding parallel to another link AB and is connected to the stub axles of the two front wheels by means of two similar bell crank lever ACK and DBK pivoted at A and B respectively. The cross link KL slides inside in the bearing and carries pins at its end k an L. the slide blocks are pivoted on these pins and move with the turning of bell crank levers as the steering wheel is when then vehicle is running straight, the gear said to in its mid position. The short arms AK and BL are inclined an angle $90+\alpha$ to their stub axles AC and BD. The correct steering depends upon a suitable selection of cross-arm angle α , and is given

$$\tan \alpha = b / 2L \quad (2)$$

L= wheel base

The range of b/L is 0.4 to 0.5 hence α lies between 11.3 and 14.10. Where b = AB distance between the pivots of front axles.

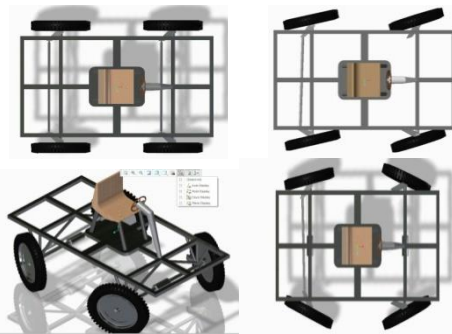


Fig. 1: Davis gear mechanism

III. ANALYSIS AND CALCULATIONS

A. Line diagram of the prototype

The figure shows the line diagram of prototype which indicates the linear dimension of the prototype as well as the instantaneous centre of body, when the wheels are inclined in required position for 360° rotation.

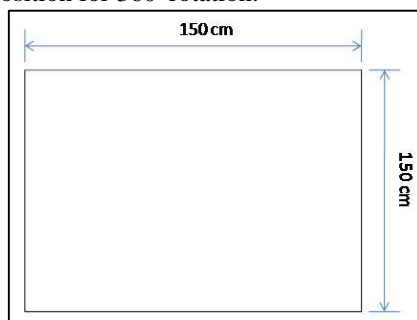


Fig. 2: Line diagram of the prototype

The dimension of the prototype were given below

Wheelbase = 55cm

Track width = 55cm

Frame length = 72 cm

Frame width = 44cm

Distance of instantaneous centre from rear left wheel = 55cm.

As evident from the fig, The instantaneous centre falls at the geometric centre of the protoptype, and as a result the path of the wheels trace a circular path ,the steer angles for the inner and outer wheels during normal steering operation were also.

IV. ADVANTAGES

- Cornering of the vehicle becomes much easier even in a sudden narrow road.
- As parallel parking is a great way to park a vehicle which reduces traffic thereby four wheel steering system helps tremendously in parallel parking.
- Changing of lane is done in much simpler way without much danger of drift.
- It provides better handling to the driver

V. DISADVANTAGES

- Wear and tear of wheel occurs in short period of time.
- Sudden uneven increase in work load in front wheel can be dangerous.

VI. CONCLUSION

By the experimental we conclude the result

- 1) The working of four wheel steering system is a new concept that can improve the working parameters in a car.
- 2) We worked with different mechanisms to make the working simpler.
- 3) The manufacturing of the components is done in much simpler manner in our own workshop.

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