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# Design & Synthesis of Four Wheel Steering Mechanism

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**Abstract:** The objective of this paper is to analyze the steering mechanism of an automobile for the purpose of making a mechanism which is capable of turning all the four wheels of the automobile simultaneously whether in same or different directions as per the requirement so as to utilize the steering mechanism of the automobile in an effective way and to reduce the efforts applied by the driver to park the vehicle in a limited space or to reverse the vehicle direction. The steering mechanism plays a vital role to balance all the four wheels of the automobile while a vehicles moves in a definite direction. In this paper an attempt has been made to develop such a mechanism which can turn all the four wheels of automobile simultaneously which could be beneficial to make an effective turn as well as can assist in parking the vehicles. The radius covered by the vehicle to reverse its direction by both two wheel and four wheel steering mechanism has been calculated as well as experimentally evaluated.

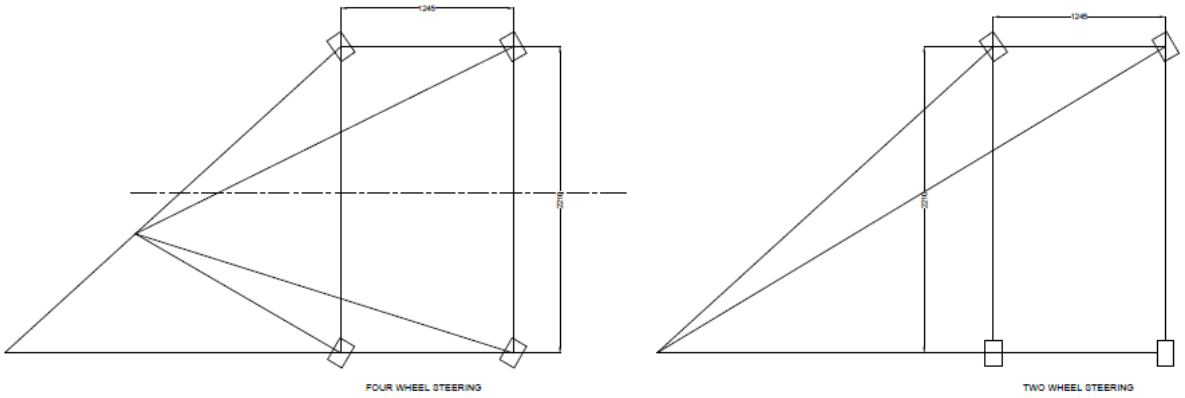
**Keywords:** Maruti 800, steering mechanism, turning radius etc.

## I. INTRODUCTION

Steering is the term applied to the collection of components, linkages, which will allow for a vessel or vehicle to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function. Steering is a system that is used in all type of transport to control the movement of the vehicle. The steering system allows the driver to guide the moving vehicle on the road and turn it right or left as desired. The various functions of the steering wheel are, to control the angular motion the wheels; direction of motion of the vehicle, to provide directional stability of the vehicle while going straight ahead, to facilitate straight ahead condition of the vehicle after completing a turn , the road irregularities must be damped to the maximum possible extent. This should co-exist with the road feel for the driver so that he can feel the road condition without experiencing the effects of moving over it. The most conventional steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver, through the steering column, which may contain universal joints to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear–wheel steering. Four wheel steering is a method developed in automobile industry for the effective turning of the vehicle and to increase the maneuverability. In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. In four wheels steering the rear wheels turn with the front wheels thus increasing the efficiency of the vehicle. The direction of steering the rear wheels relative to the front wheels depends on the operating conditions. At low speed wheel movement is pronounced, so that rear wheels are steered in the opposite direction to that of front wheels.

At high speed, when steering adjustments are subtle, the front wheels and the rear wheels turn in the same direction. By changing the direction of the rear wheels there is reduction in turning radius of the vehicle which is efficient in parking, low speed cornering and high speed lane change. In city driving conditions the vehicle with higher wheelbase and track width face problems of turning as the space is confined, the same problem is faced in low speed cornering. Usually customers pick the vehicle with higher wheelbase and track width for their comfort and face these problems, so to overcome this problem a concept of four wheel steering can be adopted in the vehicle. Four wheel steering reduces the turning radius of the vehicle which is effective in confined space, in this project four wheel steering is adopted for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle. Two wheel steering system is able to control the vehicle but it is not enough to drive the vehicle in small, narrow space or in traffic. So this project relies on this concept and has four wheels steering to control the vehicle in almost all condition. From past research, we were observing that four wheel steering system is not completely effective at a high speed. Because at high speed vehicle cannot take a turn using four wheels and if using then there will be a chance of skidding. We are going to improve steering by combining 4WS and 2WS systems. In this project, the rear wheels are disengaged from the front wheels at a high speed and at a low speed both front and rear wheels are steered the vehicle. When the vehicles require taking a sharp turn then the rear wheels turn in the opposite direction of the front wheels so the

vehicles take a turn at low turning radius. In order to accomplish this concept, Ackerman's steering mechanism is installed and mechanical linkages are used to connect front and rear wheel steering in this project. 4 Wheel Steering System is employed in vehicles to achieve better maneuverability at high speeds, reducing the turning circle radius of the car and to reduce the driver's steering effort. In most active 4 wheel steering system, the guiding computer or electronic equipment play a major role, in our project we have tried to keep the mechanism as much mechanical as possible which can be easy to manufacturing and maintenance as well as easy to operate. All wheel steering improve the stability and handling of vehicle while taking sharp turns. In that steering system, the all wheels are to be steered according to the steer perform to drive towards left or right. It should not be confused with four-wheel drive in which all wheels of a vehicle are powered.




## II. METHODOLOGY

**A. Objective of Project:**

**The main objects of the present paper are:**

**1.** To learn about the different components used in the steering system of automobile.
**2.** To know how a vehicle is being steered with conventional steering system.
**3.** To find out the alternative way for steering a vehicle in an efficient way within a less turning radius and usually while parking the vehicle.
**4.** To know how a four wheel steering system actually works.
**5.** To study the mechanism used in simultaneous turning of all four wheels of automobile.
**6.** To save the area for turning and the power applied by the driver.
**7.** To make the vehicle reverse or to turn it through 360o by four wheel steering system.
**8.** To practically enhance the knowledge about the automobile.
**9.** To learn how to modify the existing engineering model so as to make its performance better and increase its efficiency.

**B. Specifications of the Vehicle:**

The experimented vehicle in the present paper is Maruti 800 employed with both two wheels and four wheel steering mechanism having specifications as mentioned below:

**Table 1**: Specifications of Maruti 800

| Sr. No. | Parameters | Dimensions |
|---|---|---|
| 1 | Wheelbase | 2210 mm |
| 2 | Steering Ratio | 14.89 |
| 3 | Lock To Lock Turns | 2.87 |
| 4 | Track Width Front And Rear | 49″ |
| 5 | King Pin Centre To Centre Distance | 41″ |

## III. OPERATION AND WORKING OF THE MECHANISM

As stated above that in this project, we have employed both two wheels as well as four wheel steering system. The vehicle in normal condition operates in two wheel steering mode while moving straight on the road and there is no need of making the vehicle four wheels steered, since the vehicle has to operate in a normal working condition i.e. only keeping the wheels straight and providing right and left direction steering of front wheels as required. But as the vehicle comes in a situation where it needs all the four wheels to be coupled to the front steering wheel, a lever is provided next to the driver seat so as to engage the rear steering mechanism to the front steering mechanism by pulling up the lever. Thus this engaging lever engages the front steering wheel to rear steering mechanism by the mechanical linkages provided in between these two steering mechanism. Once the all four wheels of the vehicle get coupled to the steering wheel the steering wheel does its function and makes all the four wheels of the vehicles to steer simultaneously and the operation of four wheel steering is performed. Once this process is over the wheels are brought back again to the straight position and the lever is pulled down to disengage the rear steering mechanism with the steering wheel and the vehicle again becomes a normal two wheel steering system.

## IV. RESULTS

The main motto of employing the four wheel steering system was to reduce the turning radius of the vehicle and to make the vehicle getting a 360o turn in a very confined space, this mechanism was so developed for the purpose. By employing this mechanism we have successfully reduced the turning radius by approximately 50% to that of radius covered with two wheel steering system.

**The results obtained by calculations and experimental basis are tabulated below:**

| Turning Radius | Two wheel steering | Four wheel steering |
|---|---|---|
| By calculation | 4.6 m | 2.7 m |
| By experiment | 5.6 m | 2.78m |

**Table 2:** Comparison between turning radius of 2WS and 4WS

## V. CONCLUSION

As per the focus of the project we have created an innovative 4 wheel active steering mechanism which is feasible to manufacture, easy to install and highly efficient in achieving in-phase and counter-phase rear steering with respect to the front wheels using pure mechanical linkages without involving any electronic devices. This system assists in high speed lane changing and better cornering. It combats the problems faced in sharp turning. It reduces the turning circle radius of the car and gives better maneuverability and control while driving at high speeds, thus attaining neutral steering. Moreover components used in this system are easy to manufacture, material used is feasible, reliable and easily available in market and also cost is quiet less. The system assembly is easy to install and light in weight and can be implemented in all sections of cars efficiently.

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