

ZERO RADIUS TURNING AND FOUR WHEEL STEERING SYSTEM

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INTRODUCTION:

- ❖ The steering system allows the driver to guide in desired path.
- ❖ In 4 wheel steered vehicle both front wheels and rear wheels can be steered according to speed and space available for turning.
- ❖ Four wheel steering vehicle operates in 2 configuration they are as follow: **Crab steering and Zero radius turning vehicle.**
- ❖ 4 wheel steering is a method developed by automobile industry for effective turning of vehicle.

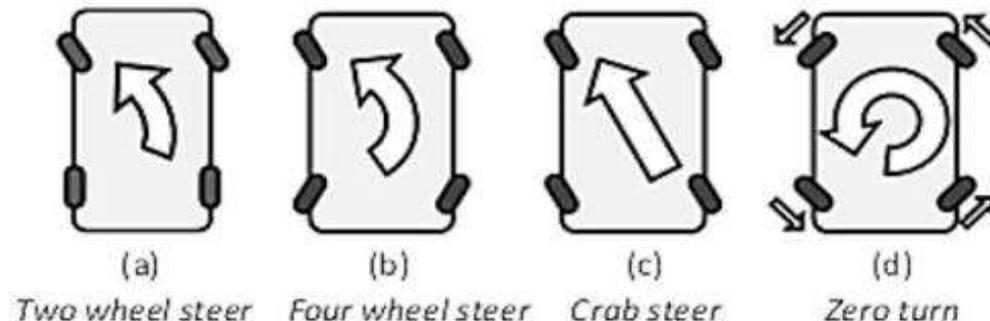




FIG: JEEP HURRICANE WITH 4 WHEEL STEER SYSTEM

LITERATURE:

1. **Er. Amithesh kumar et al worked on “Zero turn four wheel steering system”.**

This paper describes that wheels connected to front axle turned opposite to each other and so are connected in rear axle. The various function of steering wheel are to control angular motion of the wheel and provides directional stability to vehicle.

They concluded modification led to decrease in time required for turning and more suitable in parking at home and multiplex.

2. **Bansode S. P et al worked on “Zero turn vehicle”.**

This paper describe that how to avoid the complication in steering system by new concept of zero turn vehicle with pneumatic operated system.

After analysing the system, they concluded that by using this technology the turning radius of vehicle is reduced and causing advantages like easy parking, easy removal of vehicle from traffic jam, easy turning back at narrow roads.

3. Arun singh, Abhishek kumar studied on “four wheel steering”.

This paper describes that the four wheel steered vehicle is optimally controlled during a lane change maneuver in 3 types of conditions, low speed, medium speed, high speed maneuver. They analysed on steering modes and gave importance to **Crab steering mode**.

From this study, they concluded that 4 wheel steering imposes maneuverability in cars and have better stability, less body lean during changing lane and reduction of vehicle oscillation around it's vertical axis.

4. Parikshit K. Patel et al experimented on “Centrally and Radially adjustable zero turning four wheel steering system”.

This paper illustrates zero turning and 4 wheel steering system using 3 concepts. **Concept 1** Front and rear steering rack is connected using mechanical shaft. **Concept 2** Front and rear steering rack is connected using hydraulic hoses. **Concept 3** Front and rear steering rack is connected using toggle disk and connecting rod.

They studied and compared this concepts with conventional steering system and concluded that 4 wheel steering system has superior cornering stability, improved steering response and precision, high speed straight line stability, improved rapid lane change maneuver, smaller turning radius and effective turning.

5. **K. Lohith, Dr. S.R. Shankapal et al “Design and Fabricated four wheel steering system of a car”.**

In this paper they analysed the concept of four wheel steering system and developed a model considering **Maruti Suzuki 800** as benchmark vehicle, such that it can be change from 4 wheel steer to 2 wheel steer when its required.

They compared 4 wheel and 2 wheel steer mode and found many advantages in 4 wheel steered vehicle like turning efficiency, cornering stability, rapid lane changing and precision. And concluded that turning radius is reduced to 50.43%.

6. Dilip S Choudhari design and fabricated on “Four wheel steering system for Future”.

In this paper, 4 wheel steering is represented as **Quadra steering**.

Quadra steering system was explained using 3 phases, i.e. Negative, Positive, and Neutral Phases. In low speed Negative Phase is used, in high speed Positive Phase is used, the vehicle can be converted to 2 wheel steer by using Neutral Phase.

By experimenting this model he found that, Quadra steering offers 21% reduction in turning radius and improvement in stability, handling control in high speeds.

COMPONENTS:

1. BASIC FRAME:

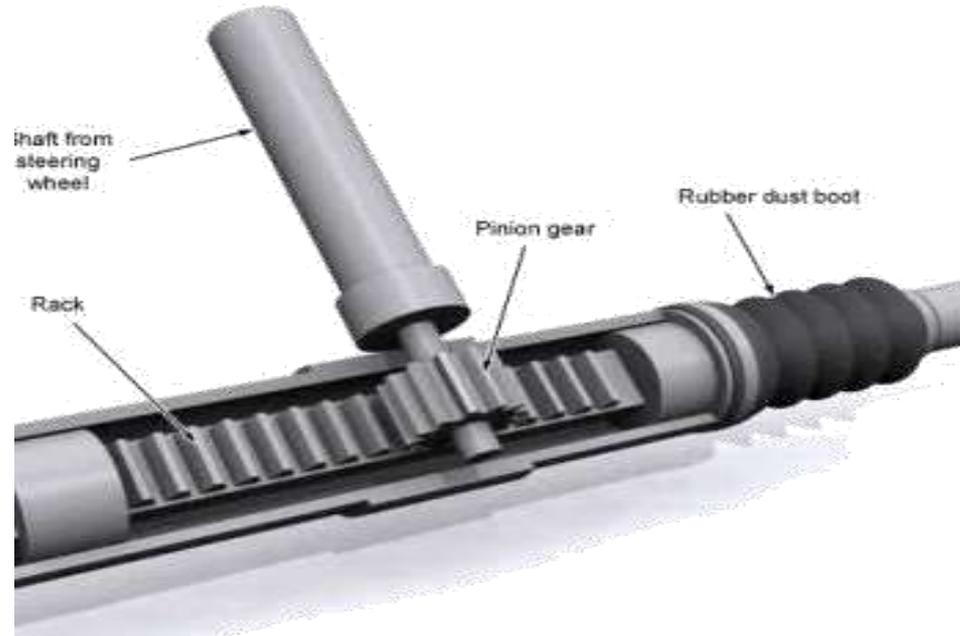
- ❖ The hollow square pipes of material of **Mild steel** are selected for frame.
- ❖ The pipes are cut into required size by cutting machine.
- ❖ The end of pipes cut into 45 degree to form rectangular frame.
- ❖ After cutting, the end of square pipes is grinded so that it became smooth and convenient for welding.
- ❖ The square pipes are welded together to form a rectangular basic frame.



FIG: BASIC CHASIS OF THE VEHICLE

2. RACK AND PINION MECHANISM:

- ❖ The rack and pinion arrangement converts rotatory motion into linear motion.
- ❖ The circular gear called **“THE PINION”** engage teeth on a linear gear bar called **“THE RACK”**.
- ❖ The rotational motion applied to the pinion causes the rack to move



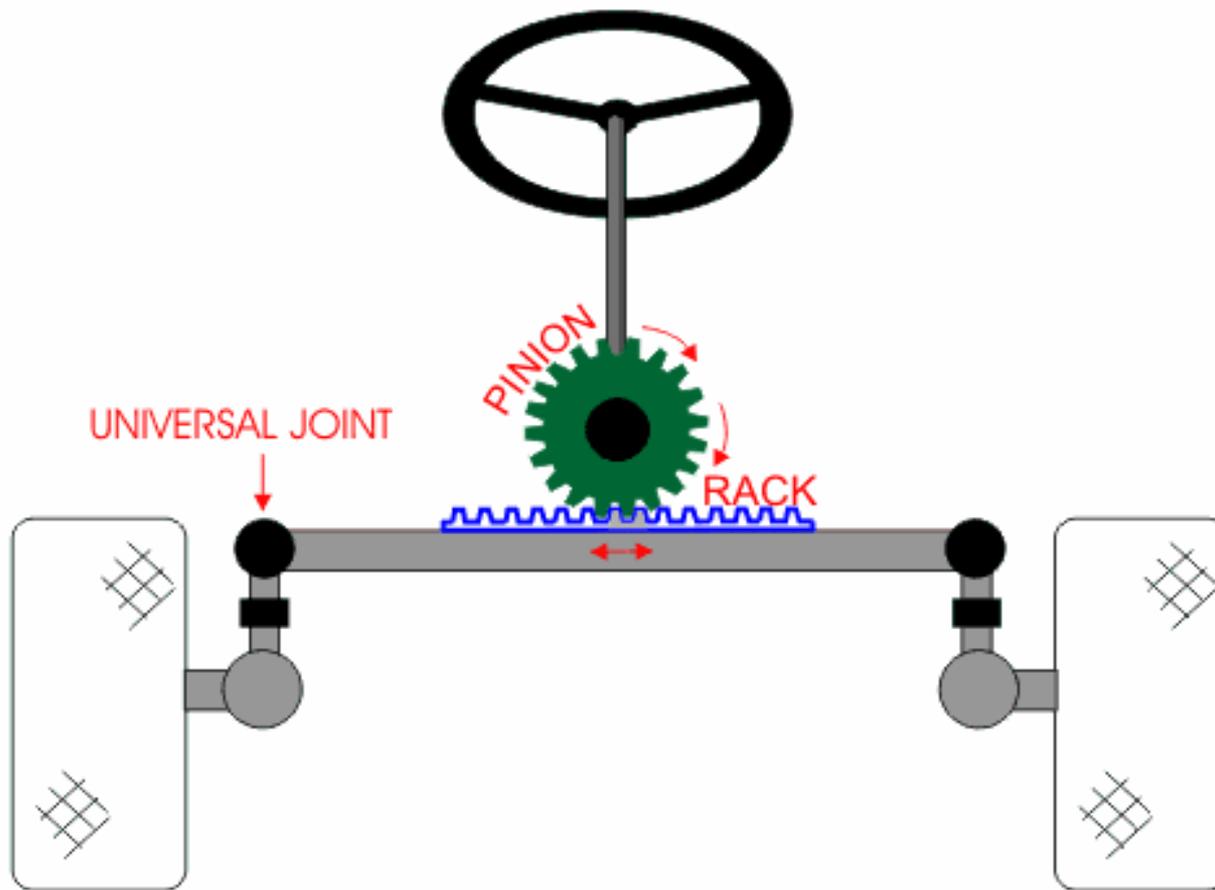
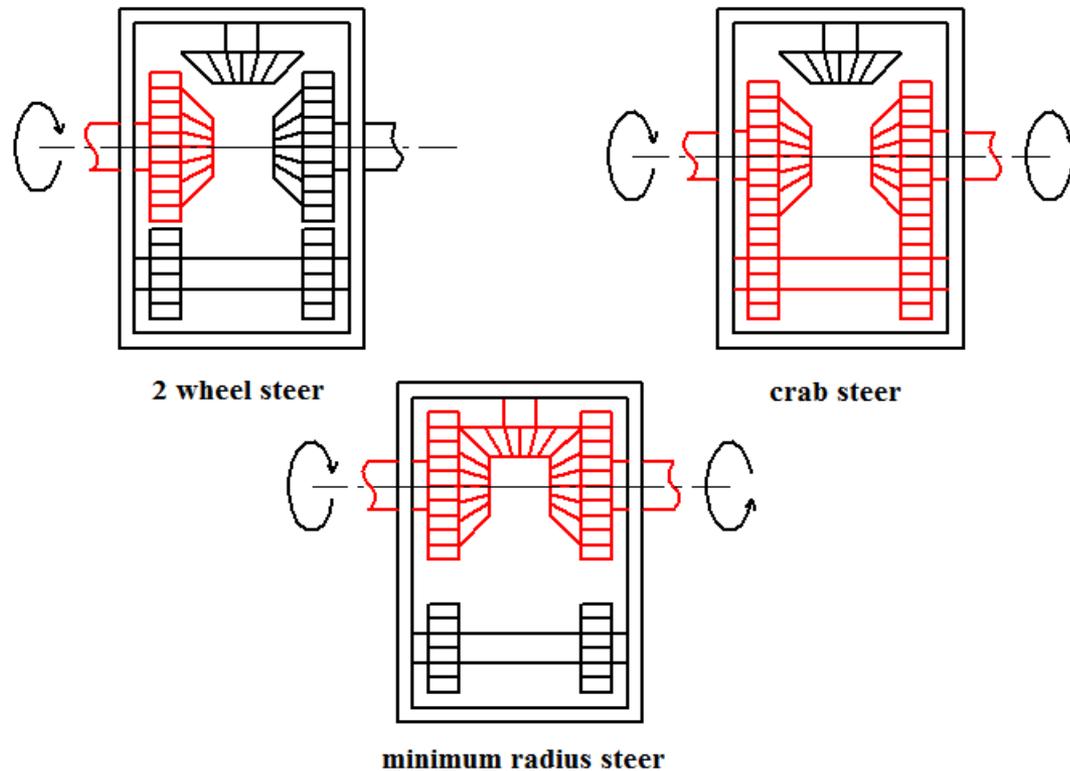


FIG: RACK AND PINION ARRANGEMENT IN VEHICLE

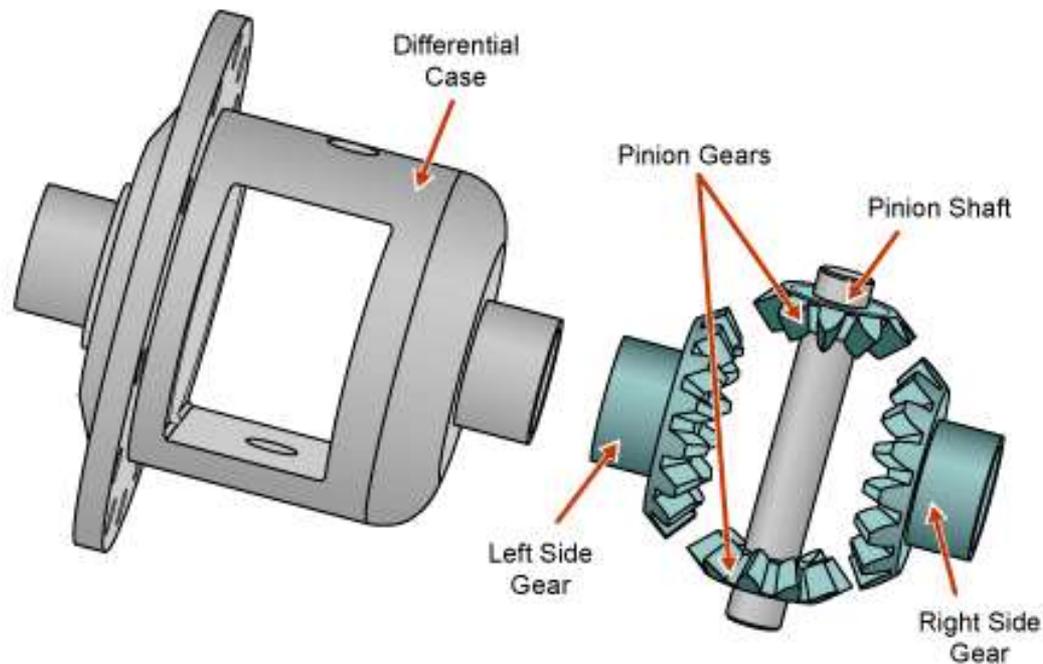
3. STEER TRANSMISSION CASE:

- ❖ The Steer transmission case consist of 3 bevel gears and 4 spur gear.
- ❖ It allows driver to convert 4 wheel steering system to 2 wheel steering system and vice-versa.



4. AUTOMOTIVE DIFFERENTIAL:

- ❖ The automotive differential is designed to drive a pair of wheels while allowing them to rotate at different speed.
- ❖ It is used to transmit the power from drive shaft to the drive wheels.
- ❖ Below shown figure is open differential.



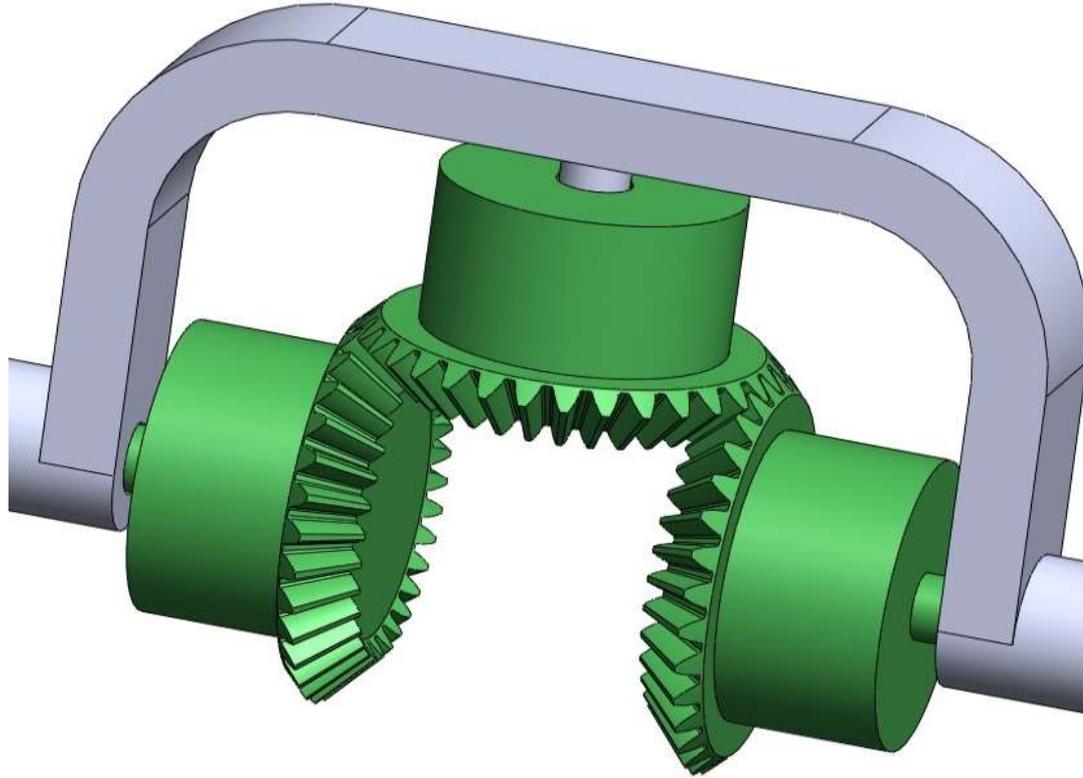


FIG:OPEN DIFFERENTIAL

5. TIE ROD:

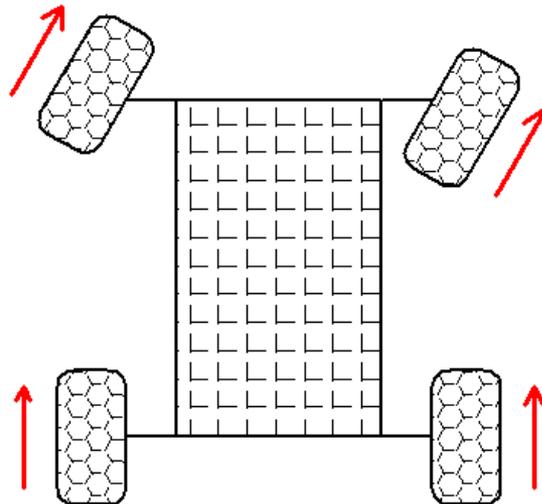
- ❖ The tie rod is a part of the steering mechanism in a vehicle.
- ❖ The tie rod transmits force from the rack gear to steering knuckle, this will cause wheel to turn.
- ❖ If tie are not regularly inspected then common problems like **Tyre wear, Vibration, Shaking and Vehicle pulling to one side** will occur.



MECHANISM AND WORKING:

1. TWO WHEEL STEER:

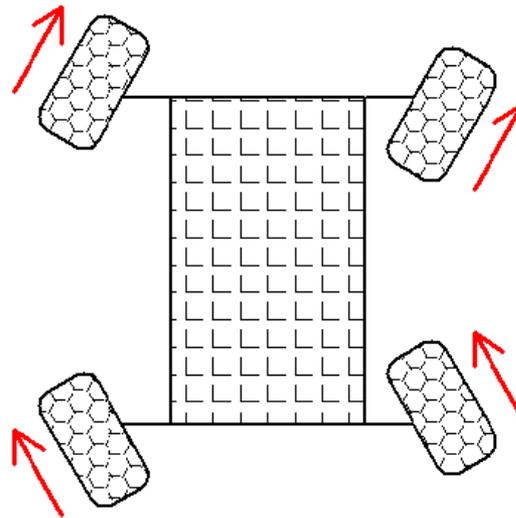
- ❖ In two wheel steer system, front wheels takes turn while the rear wheels are restricted to turn and follows the front wheels.
- ❖ In this mode only the front wheels is steered and rear wheels follows the front wheels.



TWO WHEEL STEER

2. FOUR WHEEL STEER:

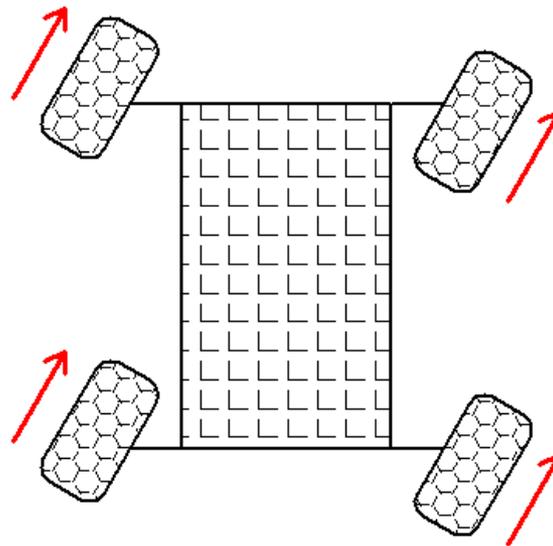
- ❖ In this condition, rear steering rack moves in direction opposite to that of front steering rack.
- ❖ Thus, it allows vehicle to take sharp turn with minimum turning radius which takes place at slow speed.
- ❖ This condition is Four wheel steering condition. This system improves the cornering capabilities.



MINIMUM RADIUS STEER

3. CRAB STEER:

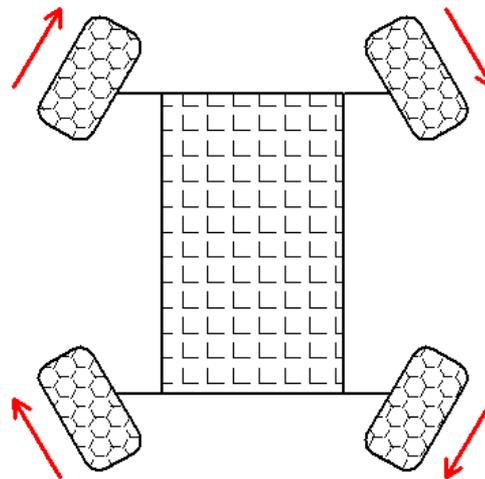
- ❖ In this condition, both front and rear steering rack moves in same direction.
- ❖ It cause the vehicle to move in sideways, i.e. in Crab like manner.
- ❖ It enables the vehicle to be driven stably in high speed while lane changing.



CRAB STEER

4. ZERO RADIUS TURNING:

- ❖ This vehicle provides circular path i.e. vehicle turns at the same place where it's standing.
- ❖ In this condition, the tie rod will shift to another end and angle of wheel is so set that the vehicle moves in circle of Zero radius.
- ❖ In zero turn steering system the angle of wheel so set that, the vehicle moves in circle of zero radius.



ZERO RADIUS TURN

ADVANTAGES:

- ❖ Superior cornering stability.
- ❖ High speed lane changing.
- ❖ Small radius of turning.
- ❖ High speed straight line stability.

DISADVANTAGES:

- ❖ Complex mechanism.
- ❖ Expensive construction.
- ❖ High maintenance cost.

APPLICATIONS:

- ❖ Parking.
- ❖ U –turn.
- ❖ Turning on narrow roads.
- ❖ Slippery roads.
- ❖ Junctions.
- ❖ High speed lane changing.
- ❖ Agricultural applications.
- ❖ Military applications.

CONCLUSION:

- Mechanism is complex and expensive.
- Cost may drop as system become common.
- Even though it's advantageous over 2WS system, 4WS is complex and expensive.

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THANK YOU