iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3127

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Design and Fabrication of Four Wheel Steering System

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Abstract: ***In this modern era, with the number of vehicles on the road is increasing day by day, Along with which comes in the following problems such as traffic congestions, limited parking area, lack of space on the road etc. It has become very difficult to handle a commercial four wheeler in these situations. Therefore a four wheel steering mechanism (where all four wheels can be turned) can be incorporated into it by replacing the conventional two wheel steering system. A four wheel steering system reduces the turning radius of a vehicle by more than 25%of its initial value, thus making a very large difference in the turning radius of the vehicle. It also provides very high stability and manoeuvrability to the vehicle and can be utilized for high speed cornering, easy parking and for taking sharp turns in hilly areas. It mainly overcomes the problem of under steer/over steer that if found in normal production cars equipped with normal two wheel steering mechanism.***
Keywords: four wheel steering, turning radius

I. INTRODUCTION

Steering is the term applied to the collection of components. It is utilized to control the direction of motion of the vehicle. The system allows the driver to direct the vehicle with Very less effort [1]. The front-to-rear wheel alignment plays a significant role in the directional stability of a vehicle. Lack of stability can cause a dangerous drive. To improve the stability of most of cars nowadays are designed to exhibit under-steer characteristics when driven at high speeds. Although under-steer condition improves stability of the vehicle, it increases the driver's steering effort. Also since a vehicle handling changes with road speed, the response to a steering movement, both in time and direction, is difficult to predict. The issues can be overcome to a great extent by using four wheel steering system (4WS). Steering of a four wheel vehicle is, as far as possible, arranged so that the front wheels will roll truly without any lateral slip. The front wheels are supported on front axle so that they swing to the left or right for steering. This movement is produced by gearing and linkage between steering wheel in front of the driver and the steering knuckle or wheel. The complete wheel arrangement is called the steering system.

II. COMPONENTS

A. Steering Wheel

Utilized to control the steering operation.

B. Steering column

It connects the steering wheel and the steering rack.

C. Steering Rack and Pinion

Utilized to convert steering wheel rotation into linear motion and transmit them to the wheel through steering linkages such the wheels can be turned accordingly.

D. Steering linkages

Steering linkages are a combination of rods and arms which helps to transmit the movement of the linear motion from the rack and pinion to the left and right wheels.

III.REQUIREMENTS OF STEERING SYSTEM

A. The Steering System Has The Following Requirement

1) Excellent mobility is accomplished when the vehicle is cornering on a thin, curving street; the directing framework must have the capacity to turn the front wheels forcefully yet effortlessly and easily.

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2) Appropriate directing exertion if nothing is done to forestall it, guiding exertion will be more prominent when the vehicle is ceased and will diminish as the speed of the vehicle increment. Consequently, with a specific end goal to acquire facilitate the directing exertion and to get better feel of the street, the guiding ought to be made lighter at low speeds and heavier at high speeds.

3) Smooth recuperation while the vehicle is turning, the driver must hold the directing wheel solidly bringing about weight on the arms. After the turn is finished, in any case, recuperation – that is, the arrival of the wheels to the straight-ahead position – ought to happen easily as the driver unwinds the power with which he is turning the guiding wheel.

4) Least transmission of stun from street surface Loss of guiding wheel control and transmission of kickback because of street surface harshness must be stayed away from. [2]

IV. ACKERMANN'S STEERING MECHANISM

Ackermann controlling geometry is a geometric game plan of linkages in the directing of a vehicle or other vehicle intended to take care of the issue of wheels within and outside of a swing expecting to follow out circles of various breadths. The goal of Ackermann geometry is to keep away from the need for tires to slip sideways when following the way around a bend. The geometrical answer for this is for every one of the 4-wheels to have their axles masterminded as radii of a hover with an inside point normal. As the back wheels are settled and don't take dynamic part in controlling, this middle point must be on a line stretched out from the back pivot. Crossing the tomahawks of the front wheels on this line also requires that within front wheel is turned, when guiding, through a more noteworthy point than the outside wheel. [3]

A. Turning Radius

The turning span or turning circle of a vehicle is the breadth of the littlest round turn that the vehicle is fit for following. It is by and large followed by the back match of wheels of the vehicle. It is resolved hypothetically by

Turning circle span = {track/2} + {wheelbase/sin (mean steer angle)}

V. FOUR WHEEL STEERING

Four-wheel controlling, 4WS, all-wheel guiding, gives a way to effectively direct the back wheels amid turning moves. A system that uses every one of the four wheels to control the auto.

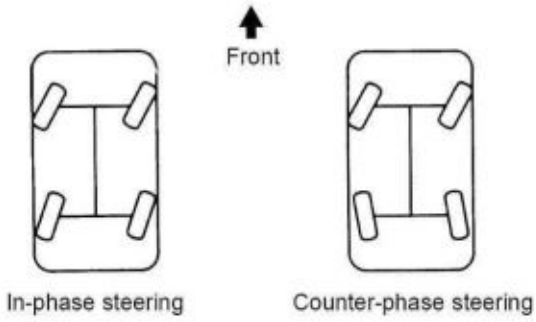

Figure 5.1: Four Wheel Steering

Two modes are mostly used in four wheel controlling which are as per the following:

A. Slow Speeds - Rear Steer Mode

At moderate speeds ideally cry 80kmph, the back wheels hand over the course inverse regarding the front wheels. It can decrease the turning circle span by 25%, and can be similarly viable in congested city conditions, where U-turns and tight roads are made less demanding to move.

B. High Speeds – Crab Mode

In high speeds for the most part at over 80kmp, turning the back wheels through a point inverse to front wheels may prompt vehicle insecurity. Henceforth, at speeds over 80 kmph, the back wheels are handed over a similar heading of front wheels in four-wheel directing frameworks. [4]

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C. Working Principle

The directing is turned the power is exchanged to the text style guiding box and an incline outfit game plan is made to exchange the ability to the back controlling apparatus box. At that point the angle outfit is used to transmit the rotating movement oppositely, so the one slope equip is presented in front controlling pole. Two backings are used to help the exchange bar. Exchange bar is associated with the back guiding apparatus box. Raise guiding rigging box is settled to the body by screws and nuts and the finishes of the controlling box are associated with the back wheel centre where the tires are mounted .as the directing is turned the back wheels hand over inverse bearing.

VI.DESIGN & FABRICATION OF THE CHASSIS

The 3D model of the case was made with the assistance of strong works programming. The suspension measurements, for example, the track width and the wheel base reassemble to those of the maruthi 800. Empty Square bars where used with a specific end goal to manufacture the suspension. Since square bars are utilized it turns out to be simple so as to mount rest of the parts. The bars were cut into the required measurements as those of the maruthi 800. In front a stub axel was used with a specific end goal to mount the front haggles combine of axel those utilized as a part of the front of an auto which bolsters both power transmission and also directing is used in the back of the vehicle. For control transmission cycle chain and sprocket were used. Two rack and pinion, those of maruthi 800 were utilized to interface the front two wheels and in addition the back two wheels. Two sets of incline adapt, one sets associated with the front rack and pinion and another match to the back rack and pinion. The riggings are thusly associated with the assistance of an empty shaft. The mixes of riggings result in inverse guiding of match of wheels concerning each other.

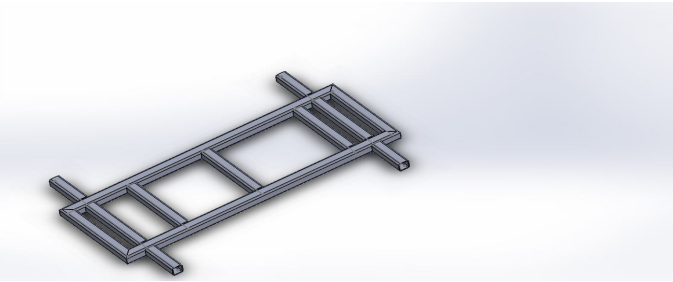

Figure 6.1: 3D design of chassis

Figure 6.2: Left side view of the prototype of the vehicle

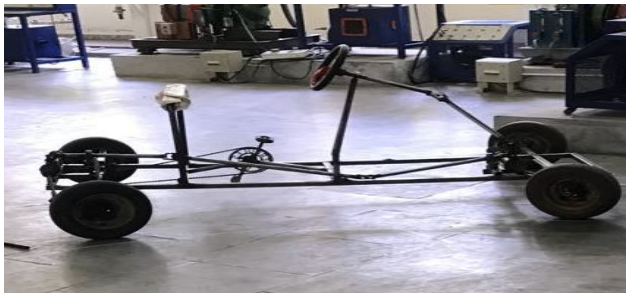

Figure 6.3: Right side view of the prototype of the vehicle

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VII. STRESS & DISPLACEMENT ANALYSIS OF THE CHASSIS

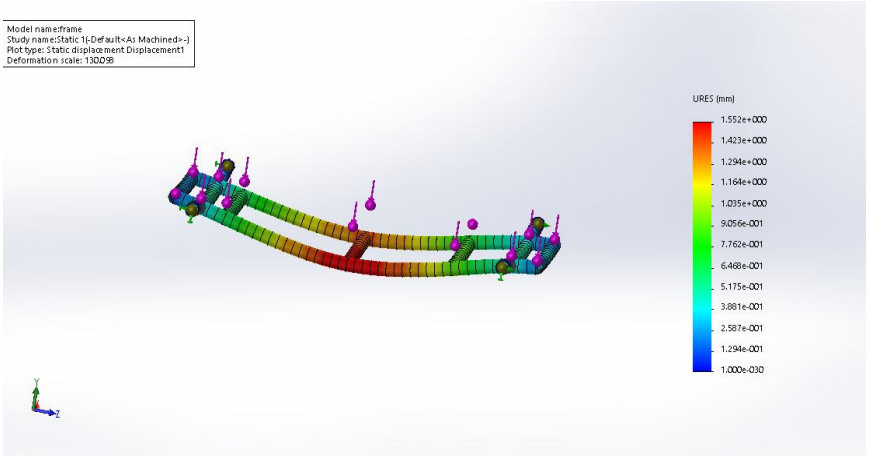

Figure 7.1: Frame-Static displacement analysis

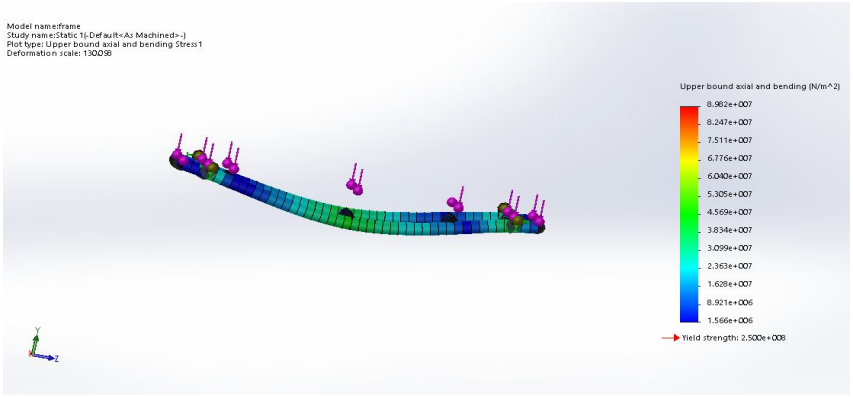

Figure 7.2: Frame-Static stress analysis

The static pressure and uprooting investigation was done on the plan frame utilizing the strong work programming. Proper limit conditions were given with suitable load. The investigation figure (4.2.2 and 4.2.1) demonstrates an enormous twisting at the inside piece of the suspension because of the stacking conditions.

VIII. PROCESS ANALYSIS AND RESULT

Figure 8.1: Turning circle of the prototype

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Figure 8.2: Diameter measurement of the traced circle

Steady range test is performed for two wheels and also four wheel steer. At first the back angle outfit match is detached so as to get two wheel steer and steady span test is performed. At that point the back slope gears are associated with a specific end goal to acquire four wheel steer and again the test is directed. The inside purpose of the vehicle is resolved and a marker is submitted in request to follow a circle. By drawing two parallel harmonies and joining the end point corner to corner decides the inside purpose of the circle. With the assistance of an estimating tape the estimations are gotten. The hover followed by the vehicle speaks to the turning distance across of the vehicle, for two wheel steer the followed circle measurement is 8.16m and for four wheel steer the followed circle width is 4.04m. Hereafter the turning sweep of two wheel steer is 4.08m and for four wheel steer is 2.02 m.

IX. ADVANTAGES AND DISADVANTAGES

A. Advantages

1) Cornering can be accomplished much effectively and easily with greater soundness and control particularly at high speeds and in addition on elusive and wet street surfaces.
2) Straight-line solidness at high speeds of the vehicle is leverage.
3) Smaller turning range and tight space mobility at speeds howl 80 kmph.
4) Stability in path changing at high speeds is moved forward.
5) Vehicle moving on limit streets and amid stopping winds up simpler.
6) Improvement in controlling responsiveness and exactness.
7) Controllable on wet or dangerous street surfaces.
8) Relative wheel points and their simplicity to be controlled.

B. Disadvantages

1) Significantly increment in work stack for front tires.
2) Large measure of left/right weight move found in 4-wheel steer vehicle.
3) Uneven tires wear of front and back wheel.
4) The 4ws, because of development of some new parts, the framework turns out to be more unpredictable in development and costly.
5) Due to the nearness of more number of parts, the heaviness of vehicle increments.
6) It is intricate in outline and requires high upkeep. [5]

X. APPLICATIONS

A. Parallel stopping: Due to a diminishment in turning sweep the stopping and un stopping of vehicle is effortlessly performed towards the privilege or left side.

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B. High speed path changing: In this is less controlling delicate this requires a considerable measure of focus from driver since he needs to judge the space and vehicles behind them.
C. Slippery street surfaces: Due to the back wheel guiding activity on low grinding surfaces happens subsequently vehicle bearing less demanding to control.
D. Narrow Roads: Due to raise wheel guiding on limit streets with tight curves, counter stage controlling lessens the turning sweep.
E. U-Turns: By decreasing the vehicle's turning range and counter stage guiding of back wheels empowers U-Turns to be performed on limit streets easily.
F. Four wheel guiding discovered its most far reaching use in diversion vehicles, for example, creature trucks.
G. It is used in Agricultural Vehicles.

XI. FUTURE SCOPE

An imaginative component of this directing linkage outline and its capacity to drive each of the four (or two)wheels utilizing a solitary controlling actuator .its fruitful usage will consider the improvement of a four-wheel, guided power base with greatest mobility , uncompressed static dependability , front-raise wheel following, and ideal obstruction climbing ability.

XII. CONCLUSION

The usage of four wheel controlling enhances the execution of vehicle particularly in guiding and security. Four wheel directing is a moderately another advancement. The back arrangement of wheels doesn't assume a dynamic part in controlling the directing. In four wheels directing framework the back wheel can turn left and right. The target of 4WS framework is a superior strength amid surpassing moves, decrease of vehicle wavering around its vertical hub, lessened sensibility to parallel breeze, nonpartisan conduct amid cornering.

Despite the fact that it is refreshing over the ordinary two wheel guiding framework, 4-Wheel Steering is perplexing in plan and costly both in development and upkeep. It isn't monetarily feasible to supplant two-wheel guiding with 4-Wheel Steering in household autos where the buyer expects more from the innovation for the additional cost, however in substantial vehicles it gives all the more driving favourable position over cost. Four wheel directing is developing in notoriety and it is probably going to come in more new vehicles. As the framework turn out to be more typical place, the cost of four wheel directing framework will drop down.

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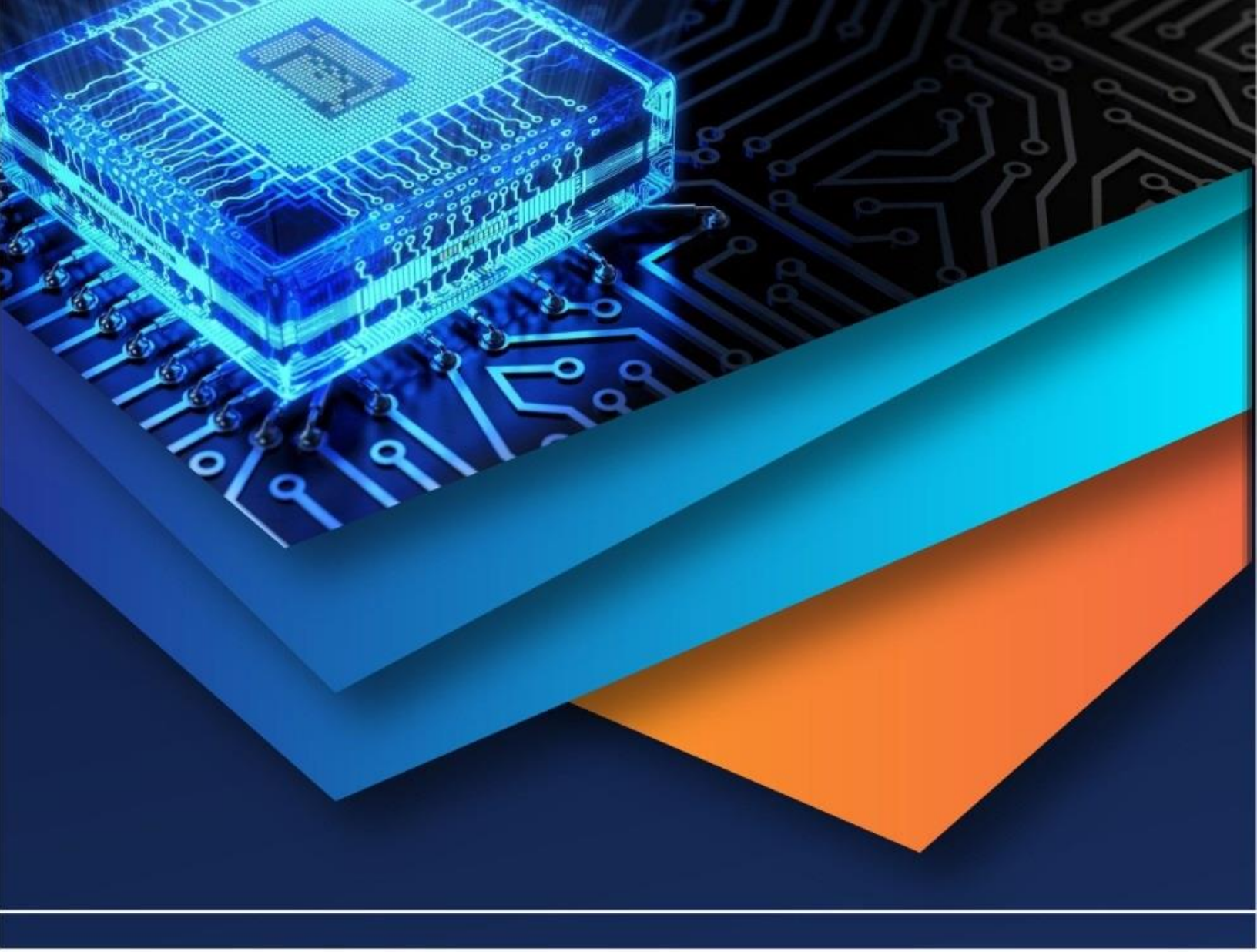

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