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VARIABLE TOE LINK: (REVIEW)

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Abstract

In day by day life, according to the demand and requirement of vehicles lots of changed done in automobiles and their dynamics, to make vehicle familiar with all type of environment, so because of that huge development in automobile occurred. In this seminar report study done on the dynamics of vehicle and concluded that need to change in some parameters in suspension system according to the terrain. If the change in position of pivot point of the wishbone or trailing arm of toe link instantaneous center will mismatch cause two different instantaneous center will form and it will trace their both different path so in which direction vehicle is going to be taking turn then another power wheel also tries to pull towards first one, so the skidding is occur in the vehicle and this may help us to get Sharpe turning and reducing the turning radius of vehicle and that can also avoid huge accident generally occur in hilly areas. In case of suspension motion ratio adjustability provide in vehicle it can also help to control the traction of vehicle with ground, so that it will be beneficial in getting acceleration of vehicle. As we use torsion bar in suspension system at lover wishbone for controlling the travel of suspension, will help in reducing the damping of vehicle, isa cause of decelerating the vehicle. It also able to overcome the terrain barriers coming during ride and able to give better control on vehicle for analyzing of above parameters, analysis of vehicle suspension system ‘’LOTUS SHARK SUSPENSIONANALYSIS SOFTWARE’’ is used, from that simulation done on suspension system.

Index Terms*: Instantaneous Center, Toe link, skidding, etc.*

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1. INTRODUCTION

Maximum dynamics and kinematics of vehicles are depend upon suspension system. When we talk about suspension system it directly deals with the how unsprung mass of vehicle is connected with the sprung mass of it. Not only this connection decides the path of relative motion of the wheels but also controls the forces transmitted between them.

Any particular geometry is to be designed to meet the need of vehicle according to their applications. There is no any single best geometry. The dynamics like castor, camber, toe, vehicle roll, and steering ability of vehicle etc. are tends to get vary according to the change in the suspension system.

It also helps to maintain correct vehicle height and wheel alignment. It also control the direction of the vehicle and has to keep the wheel in perpendicular direction for their maximum grip. The suspension system also protects the vehicle itself and also luggage’s from damage. The design of front and rear suspension of a car may vary as per requirement.

There are so many suspension system but which is actually work for proper vehicle, and also depends on it because it’s all about in which environment vehicle is going to be survive. [1]

2. TYPES OF SUSPENSION SYSYTEM

There are two types of suspension system are mentioned as follow

1. Independent type

2. Dependent type

2.1 Independent type suspension system

1. Double wishbone (A- arms) damper on lower wishbone.
2. Double wishbone (A- arms) damper on upper wishbone.
3. Double wishbone with anti-roll bar
4. Trailing arm
5. Three link trailing Arm
6. Semi-trailing arm
7. Three link Semi-trailing arm
8. MacPherson strut
9. H-arm with upper single link

2.2 Dependent type suspension system

1. Solid axle

2.1.1 Double wishbone

Double wishbone suspension (A-arm) is an independent suspension system in which wheel can travel separately without causing effects on other wheel. It have an ability to absorb the bump without disturbing the entire geometry. It having a low weight so reduced the unsprung mass ratio to sprung which is desirable. [1]

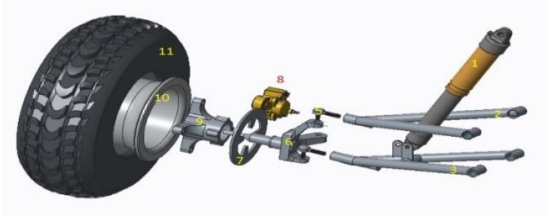


Fig-1: Exploded View of Double Wishbone Suspension System

2.1.2 H-Arm with single upper link

In h-arm suspension system one H-frame wishbone and used at rear of vehicle & is at lower and one single upper link is connected to assembly, it has low weight compare to double wishbone, trailing, semi-trailing suspension system. It can gain camber, toe during turning, cause helps to get Sharpe turning ability. [1]

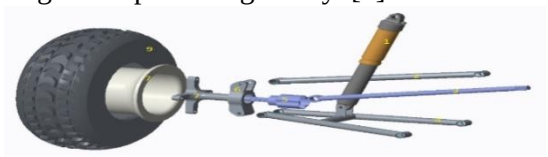


Fig-2: Exploded View of rear suspension system

2.1.3 Links Trailing

In this type of suspension system one trail is fixed and two upper and lower link is used also called as toe links. This toe links helps to get flexible in adjusting the toe and camber. As this system has more in weight so generally it get avoided but for fixed parameters it is very helpful and adjustability of same. This system unable to gain toe, camber during turning so increase the turning radius of vehicle so get understeer ability in vehicle cause reduced Sharpe turning. [1]

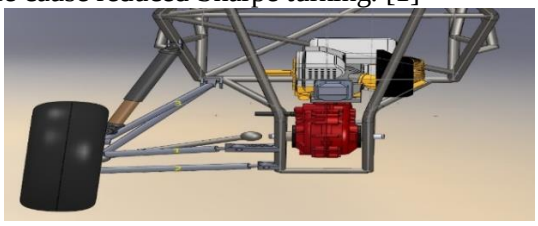


Fig-3: Link Trailing Arm suspension geometry

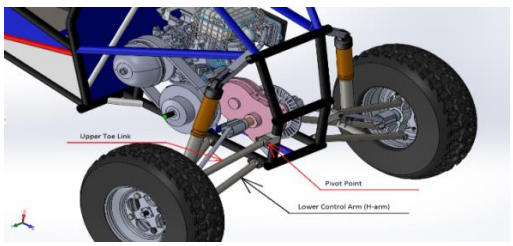


Fig-4: Vehicle rear compartment

3. TOE LINKS

3.1 TOE LINK GEOMETRY

Toe links are the most imp factor in rear suspension system which can able to control the kinematics of vehicle like toe, camber, etc. by adjusting the length of the links. As it had assembled with heim joint (rose joint) with the frame of vehicle.

Toe links can be used to balancing the 6 degree of freedom so as to optimize the unwanted unbalancing forces acting on the system and which also helps to guide the travel of vehicle and giving the straight vertical path or curve path which is totally depends upon type of suspension system. Following figures will definitely solves the confusions.

Below fig shows that toe link is connected to the frame of vehicle with the help of bracket which is also pivot about one point, this point decides the positing of instantaneous center of links. Instantaneous center which is also decides the travel of wheel as per the location of it. As the ICR as near of vehicle it will makes the wheel to skid about other one. Now we consider that positing of pivot of the link which is away from the vehicle and having nearly equal to zero camber change and toe change during bump and roll of vehicle. This results checked in the lotus shark suspension analysis software which generally not possible in actual condition. So for results cross checking it get essential to go with software, from the evaluated results we moved to the further iteration we did the observation on both results before changing the pivot and after changing of pivot.

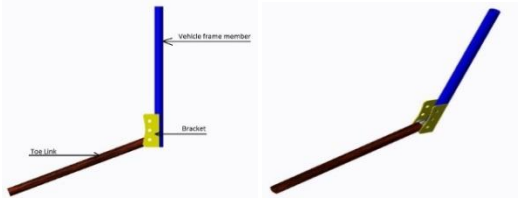


Fig-5: Rear Toe link assembly

We had mainly aware about sharpe turning and that what we are unable to get in our vehicle so it tends to gain an large turning radius of vehicle and going to understeer ability cause to increase the large turning radius in vehicle and it had also increased the race time.

As we studied on the positioning of pivote of toe links we had found that statically and daynamically camber gain an toe gain is occuring so as to cause the negative camber with getting stabillty of vehicle and negative toe gioves sharpe turning of vehicle.

Our targeted point was the turning ability of vehicle, we did lots of study to increase the steering ability and reducing the turning radius but we didn't get more positive solutions in this and decided to overlook on other parameters of vehicle depends upon the steering like suspension and transmission and we caught lots of parameter are releted to the steering so most of the our focused on suspension system and we found, as the

stiffness and toe adjustability allowable then we can overcome from this problem.[3]

3.2 INSTANTANEOUS CNTERE

Instantaneous centre is an imaginery point around which the wishbone is rotate with reference of that point which is away from the vehicle or inside the vehicle it depends upon how straight wishbone to each other if the wishbone is extended with lines as shown in below fig. then it will meet at somewhere that point is called as the instantaneous point. If the wishbone are parallel to each other then there is no any chances of meeting the extende lines so as the their instantaneous point will be at infinity and will not going to meet anywhere as they are parallel to each other.

When the wishbone and toe link matches the ICR (Instantaneous Center) then the turning radius of vehicle was large and facing problem in shrpe turning. [3]

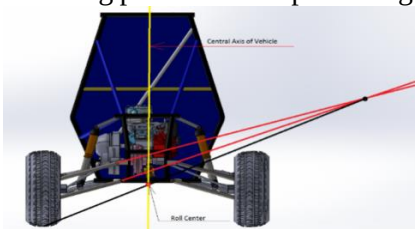


Fig-6: Instantaneous Center

3.3 TOE LINK SHACKLE POSITION 1

When the we lower h-arm line extended and toe link also as considering aft side of the vehicle then it will meet at particular point that point is called as the instantaneous point, about which the vehicle wheel will travel. If the instantaneous center will as possible as near to the vehicle it will be considered as positive point because the distance of that center will at max distance will take more time to travel and suspension travel will also be large. Figure showing that the basic or first position of the toe link which matches the instantaneous center which will take the max turning radius to turn the vehicle. [3],

This following results shows the positioning of pivot point before shackling [4]

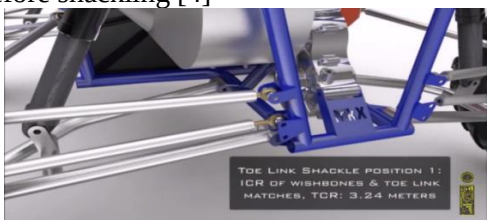


Fig-7: Pivot position before shackling of toe link

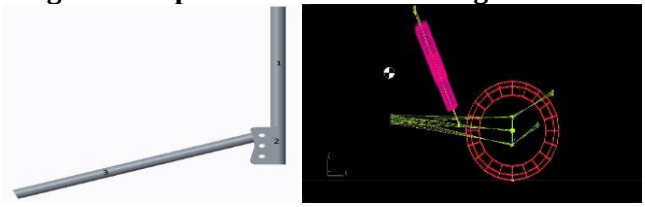


Fig-8: Toe Link Shackle Position 1

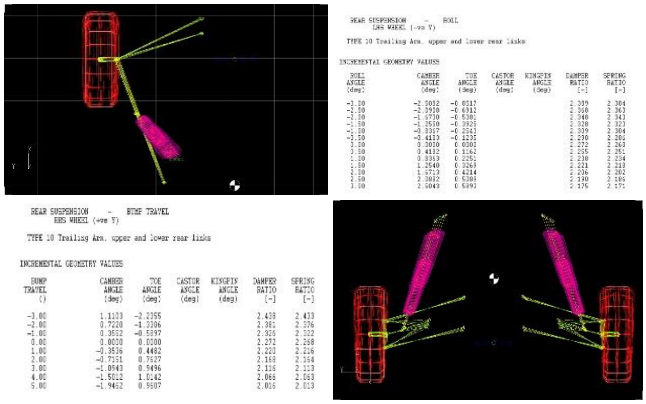


Fig-9: Lotus results before shackling pivot

3.4 TOE LINK SHACKLE POSITION 2

In this we had just shackle the position of the pivot point of toe link then it will mismatches the instantaneous center and this will tends to vehicle in skidding ability during turning and will helps in Sharpe turning.[3]

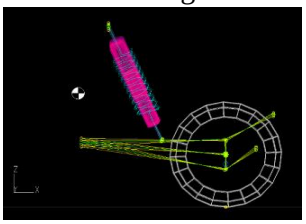
Results after the shackling of pivot point toe will change and the instantaneous centre will also get mismatch so one wheel get tries to skid because after changing the pivote point position

Fig-10: Toe Link Shackle Position 2

3.3 LOTUS SOFTWARE RESULT

In this software actual points reference to the vehicle we had feed related data in it and by doing the number of iteration of it we got the some position and the better results and we had selected better one for implementations.

For the analysis of this we used LOTUS SHARK SUSPENSION ANLYSIS *SOFTWARE* and found the results of camber gain and toe change.



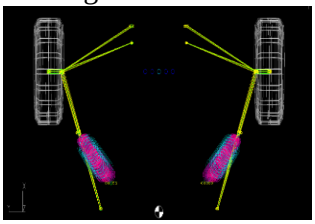
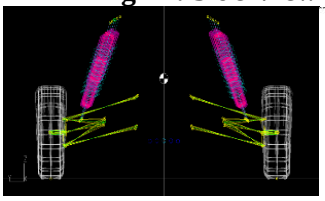


Fig-11: Side View Fig-12: Top View



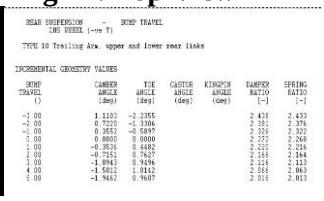
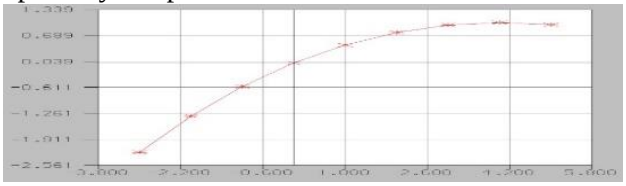


Fig-13: Front View Fig-14: Lotus results in Bump

This results shows that the camber change and toe change occuring during bump of the wheel and what parameters gets changed for verification and comparisons.

In analysis of vehicle we get the toe change is-2.2355 deg. and camber gain -1.9462 deg. After mismatching the ICR we get the above results and cause the dynamics the changes in vehicle performance of vehicle is also get changed. [4]

Graphically it represented as follows:



Graph-15: Toe change VS Wheel Travel

5. ADVANTAGES

1.Using of toe link adjustability will provide the terrain stability tackling ability.
2. It also helps get the better steering ability.
3. We can get oversteer geometry from different positing of pivot of links.
4. Well beneficial for hilly riders.
5. Will also reduce the turning time, can helps in races.

6. DISADVANTAGES

1. Need precious measurement devices.
2. Implementation is complex.
3. Consumed time for changing pivot point.
4. Pivot cannot change during vehicle is running.

7. CONCLUSION

From above we had concluded that we can control the dynamics of vehicle by changing the some small parameters of suspension system so as to achieving the better result. There are so many another factors affect on kinematics of vehicle need to concentrate on that, which will definitely will helps us to get positive results for better to vehicle. Generally what happen we failed to link one system with another one, cause not able to get the exact problem which is affecting the performance of vehicle. As the used of optimized sway bar and torsion bar will might help to get overcome from the decelerating the vehicle, and will provide anti-dive and anti-squat ability to the vehicle.

LITERATURE VIEW

Team Nemesis COEP have the fastest ATV in the world. So observing their innovative video and we had selected this innovations for paper. This innovation shows the variable toe link of ATV which effects on kinematics and dynamics of vehicle due to shackling the position of pivot point of link. All the data is taken from the references given below.

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