

Design & Analysis of Tie Rod by Composite Material

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Abstract

Tie pole is one of significant piece of vehicle guiding framework, as in vehicle its immediate contact with controlling. In vehicle linkage system is utilized to interface focus connect to controlling knuckle. The primary point of this undertaking "Plan and investigation of tie pole by composite material". Composite materials have turned out to be expanding prominent as of late. The idea here composite material is presented, as blending at least two material for changing the properties, for example, load of parts or quality. The material determination is of steel substitute, for example, aluminum, magnesium, plastic or composite material, applying fabricating as well as embracing streamlining method. The FEA investigation of Tie pole is completed to check its common recurrence, most extreme pressure examination and distortion. The most rate load of vehicle is taken by suspension framework; anyway tie pole may get flop because of fluctuating powers amid guiding and knocking of vehicle. The powers from the controlling is likewise considered amid the static state of vehicle. Vibration and exhaustion of Tie pole has been consistently a worry which may prompt basic disappointment if the subsequent vibration and stresses are extreme and exorbitant. This paper exhibits and spotlights on some Finite Element (FE) investigation of a run of the mill tie bar of a vehicle will be completed and regular recurrence will be resolved. The tie pole end is a standout amongst the most basic parts of a controlling system, which has immediate and urgent significance as far as driving wellbeing. The principle capacity of this part is to exchange the directing, originating from the guiding linkage, to controlling knuckle by means of tie decay arm. In this examination the auxiliary investigation of a tie bar end part for a van-type vehicle is done by limited component (FE) displaying of the body, the joint and the bearing. Thus, in contrast to the past examinations in writing, every segment of the tie bar end is incorporated into FE demonstrate and an entire gathering is dissected by methods for contact cooperations between parts.

Keywords - Tie Rod, FEA analysis

I. INTRODUCTION

Tie bar of Steering framework interfaces focus connect to the directing knuckle in ordinary suspension framework and rack to the guiding knuckle in McPherson suspension framework. Tie bar by and large gets compel from rack and exchange it to the guiding knuckle to turn the wheels. Tie pole is a

roundabout bar with strung part, Outer end and inward end. Tie pole is generally comprised of combination steel.

Disappointment of tie bar may cause shakiness of vehicle and can cause a mishap. So it's imperative to check the quality of tie pole. The heap going ahead tie pole is for the most part compressive. The endeavors required where vehicle is moving are nearly less with stationary vehicle. The working quality of the tie bar is that of the result of the admissible working pressure and the base cross-sectional zone. On the off chance that the strings are cut into a round and hollow bar, that base territory can be found at the base of the string. Bars are frequently made thicker at the closures and this at that point implies that the tie bar does not wind up more fragile when the strings are cut into it. Tie poles are associated at the closures in different ways. In any case, it is attractive that the quality of the association ought to be somewhere around an equivalent solidarity to that of the bar. The closures can be strung and after that went through penetrated gaps or shackles (this is a U-formed bit of metal that is anchored with a stick or fastener over the opening), and afterward held by nuts that are in a bad way on the finishes. In the event that the finishes are strung right hand and left hand, the length between the purposes of stacking might be changed. A turnbuckle is a gadget that is utilized for modifying the pressure in tie poles. Another method for making any end associations is to produce an eye or snare on the pole. It is prudent that your vehicle's controlling and suspension frameworks are checked routinely, in any event once every year alongside a total wheel arrangement. A well used tie pole can cause meandering, sporadic directing and furthermore real tire wear. In the event that a tie pole is fundamental, a wheel arrangement will likewise be required in light of the fact that tie pole substitution will exasperate the arrangement setting. As the proportion of its length to the range of gyration of its cross area is regularly very extensive, it would almost certainly clasp under the activity of compressive powers. The tie pole transmits drive from the controlling focus connect or the rack apparatus to the guiding knuckle. This will make the



wheel turn. The external tie pole end interfaces with a changing sleeve, which permits the length of the attach bar to be customizable. This alteration is utilized to set a vehicle's arrangement point. The directing and suspension arrangement of vehicle ought to be checked intermittently on the grounds that well used tie bar can make meandering of guiding and over the top tire wear. Disappointment of tie pole may happen because of ill-advised material choice, poor structure, exhaustion load and wear of tie bar. Additionally the signs given by the tie pole before disappointment is less so it tends to be unsafe.

In this examination, dissimilar to in the past reports, each and every part in the tie pole end is demonstrated independently, and the contact connection between parts is characterized in detail. The pressure esteems for each and every part are examined for various places of the joint.

II. RELATED WORK

Manik A. Patil, Prof. D.S.Chavan, Prof.M.V.Kavade [1] The led inquire about has started with production of 3D-CAD strong rough model as a multi-body framework, after that strong work was created where every single fit component thought to be superbly unbending, and in definite phase of testing limited component investigation was performed utilizing Ansys programming bundle. From the exhibited outcomes we can reason that the dispersion of misshapening and stress don't surpass the yield quality esteem and that there are neither harms nor disappointment of Tie bar. The rightness and precision of figured outcomes is as yet reliant on the determination identified with different demonstrating parameters. The absolute most imperative angle, for example, limit conditions or right work and sort of components are playing out a conclusive job in accomplishing of right outcomes. Tie bar investigation by utilizing ANSYS programming demonstrates that the twisting is 0.13302 mm and the proportional pressure is 94.66 MPa which is under pliable and compressive yield quality i.e. 250 MPa. The Tie pole experiences constant vibrations when vehicle is running. Henceforth Natural Frequency is determined in Ansys programming and its esteem is 201.30Hz. From the above outcomes the tie pole taken for investigation is protected.

Pradeep Mahadevappa Chavan, M M M Patnaik [2] Fit model of Tie bar fulfilled every quality rule and henceforth the FEA results are exact. In this venture, the exploratory firmness estimation of the acquired tie bar made out of carbon steel is 103.77 KN/mm which meets intimately with the hypothetical solidness esteem 109.23 KN/mm and solidness esteem is 118.22 KN/mm got utilizing FEA. The mistake between the trial and FEA solidness is 12.20%, which is adequate blunder. It ought to be noticed that the components which are first request

TET4 components and in trial real tie bar is utilized, the material deformities if any are there is taken consideration amid the experimentation, so this can prompt the mistakes. The common recurrence and mode states of Tie bar are gotten by ordinary model investigation. The first Mode normal recurrence of carbon steel Tie bar is 833 Hz, cast press Tie bar is 652.4 Hz and aluminum compound Tie pole is 829.8 Hz. The first Mode regular recurrence of carbon steel Tie pole segment is more noteworthy than the solid metal and aluminum Tie pole segment, so carbon steel Tie bar is increasingly reasonable material for plan of vehicle Tie pole.

M. Ozsoy, M.K. Pehlivan [3] the examination on the auxiliary static investigation demonstrates that the weights on the parts are littler than their yield esteems. In light of the basic static examination results, the most extreme worries for the joint, the body, and the heading are 211 MPa, 160.8 MPa and 9.1 MPa separately. In spite of the fact that the biggest pressure esteem happens on the joint, in light of the high return worry of AISI 5140 and the high pressure/life esteems, the littlest wellbeing factor has not the joint, but rather the body. Henceforth as indicated by the outcomes, distortion and breaking will happen on the body first. These outcomes are comparable with the breakdown information got from Teknorot A.S. At the point when the joint moves from opposite position to 25 degrees tendency, most extreme pressure diminishes by 10 MPa. At the 28 degrees tendency, the incentive at which the joint contacts the body, the most extreme worry for the joint declines by 13% and achieves the littlest esteem. Then again, with the expansion in the tendency the pressure an incentive in the body increments and achieves the biggest esteem (160.8 MPa) at tendency of 28 degrees. The most extreme pressure esteems for the direction happen at 28 degrees tendency too, when the pressure an incentive at the upper bearing winds up 9.1 MPa. The biggest number of glitches happens because of the disfigurements at the orientation, which is as per the information of the producer Teknorot A.S. The pressure esteems given in Table II appear, that the pressure esteems saw on the upper bearing is roughly 33% bigger than the ones saw on the lower bearing. The likely distortions because of this extensive distinction can be disposed of by fitting change in the material.

Mr. Pranav S. Kankarej1, Prof. Anurag A. Nema [5] A vehicle's guiding wheel is associated with controlling rigging and directing apparatus is associated with wheels of vehicle by means of the tie pole closes. The tie bar end is utilized to guarantee that the wheels are adjusted. It gives the change in accordance with wheel to adjust & keeps the tires free from wearing out on the inward and also external edges. Subsequently the working of tie pole is significant for controlling and suspension execution of vehicle. The present world is focused. Market requests for the trend setting innovation at lower cost.

This reflects in making the innovation less expensive. Thus every association taking a stab at practical item at a lower cost and inside least period for 'time to advertise. This puts parcel of weight on architects to reliably endeavor to plan the more viable items at the lower cost. The work is center around working of the tie bar, the techniques for its execution assessment its enhancement. Empty Tie bar with 11.0mm ID is chosen after investigation and further material examination is finished utilizing 11.0 mm as ID. It gives 12.76% less load than strong tie pole, without disappointment. Aluminum is proposed as appropriate material after examination.

III. METHODOLOGY

In this work, limited component examinations were completed to decide the attributes of the Tie pole. All system standards and hypotheses talked about were used to accomplish the destinations. The mix of all the investigation results were utilized to create virtual model made utilizing FEM instruments and the model was refreshed dependent on the relationship procedure.

At first the hypothetical investigation of Tie-bar will be finished. The general motivation behind Tie-bar is to transmit the movement from guiding arm to directing knuckle and support the powers and vibrations caused by knocks from tires because of uneven street surfaces. The key territories for alteration are distinguished. The primary undertaking in this examination is to discover the distortion and stresses actuated in the Tie-pole and streamlining it for different material mixes. The 3-Dimensional model is set up for Tie-bar. Diverse sorts of materials are doled out and examination is completed utilizing limited component investigation programming named Ansys Inc. The outcomes are contrasted and useful outcomes.

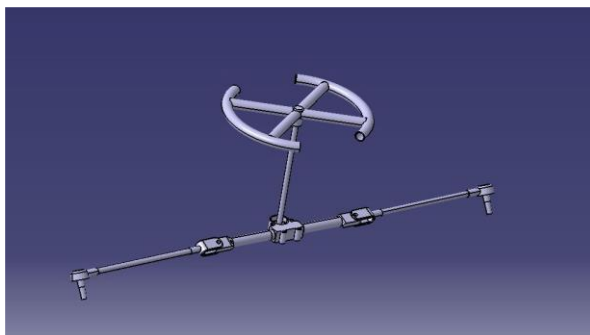


Fig 1: Assembly of Steering System

A. Length of Tie Rod

Sometimes it is also called as “Track Rod”. It is determined as follows -:

$$\begin{aligned} \text{Length} &= a - \text{tire width} - (2 * \text{Knuckle} + \text{ball joint}) - \\ &\quad \text{Rack length} \\ &= 48 - 5 - 5 - 14 \end{aligned}$$

Length of tie rod =22 inch (consideration for design)

It is the length of two tie rods.

B. Steering linkages

The guiding linkage is a mix of tie bars, and directing arms and rotating conjunctures or bar end that transmits the development of the controlling apparatus to the front wheels.

- It must transmit this development to the front wheels, while as yet taking into consideration any here and there development they may make, while the vehicle is in movement.

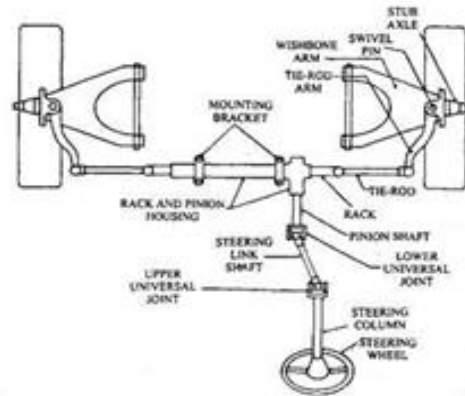


Fig 2: Steering Linkages

C. Camber

Camber point is the edge made by the wheels of a vehicle; explicitly, it is the edge between the vertical hub of the wheels utilized for controlling and the vertical hub of the vehicle when seen from the front or back. It is utilized in the plan of directing and suspension. In the event that the highest point of the wheel is more remote than the base (that is, far from the hub), it is called positive camber; if the base of the wheel is more remote than the best, it is called negative camber. Rough terrain vehicles, for example, agrarian tractors by and large utilize positive camber. In such vehicles, the positive camber point accomplishes a lower controlling exertion

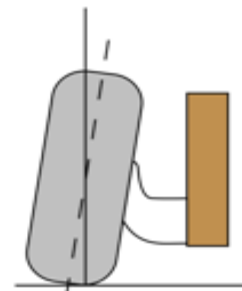


Fig 3: Camber angle

D. Caster

The caster edge or castor edge is the rakish dislodging of the guiding hub from the vertical hub of a controlled wheel in a vehicle, cruiser, bike or other vehicle, estimated in the longitudinal heading. It is the

point between the rotate line (in a vehicle a nonexistent line that goes through the focal point of the upper swiveling appendage to the focal point of the lower swiveling appendage) and vertical. Vehicle racers some of the time change caster point to streamline their vehicle's taking care of attributes specifically driving circumstances.

The turn purposes of the controlling are calculated to such an extent that a line drawn through them converges the street surface somewhat in front of the focal point of the contact fix of the tire on the asphalt by a separation called trail. The reason for this is to give a level of self-focusing for the controlling the wheel casters around so as to trail behind the hub of guiding. This makes a vehicle less demanding to control and enhances its directional steadiness (diminishing its inclination to meander). Exorbitant caster point will make the controlling heavier and less responsive, in spite of the fact that in dashing substantial caster edges are utilized for enhancing camber gain in cornering. Caster points more than 7 degrees with outspread tires are normal. Power controlling is normally important to conquer the jacking impact from the high caster point.

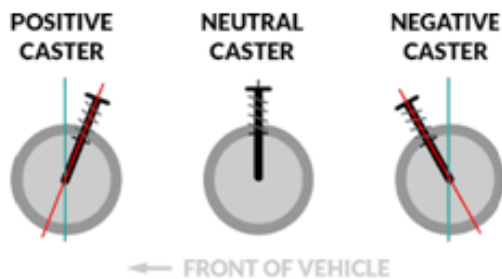


Fig 4: Caster angle

E. Toe In-Toe Out

In car designing, toe, otherwise called following, is the symmetric point that each wheel makes with the longitudinal pivot of the vehicle, as a component of static geometry, and kinematic and agreeable impacts. Positive toe, or toe in, is the front of the wheel pointing towards the centerline of the vehicle. Toe can be estimated in direct units, at the front of the tire, or as a precise redirection.

Toe is generally customizable underway cars, despite the fact that caster point and camber edge are frequently not flexible. Upkeep of front end arrangement, which used to include every one of the three changes, presently includes just setting the toe; as a rule, notwithstanding for a vehicle in which caster or camber are flexible, just the toe will require modification. One related idea is that the best possible toe for straight line travel of a vehicle won't be right while turning, since within wheel must go around a littler sweep than the outside wheel; to make up for this, the guiding linkage commonly adjusts pretty

much to Ackermann controlling geometry, changed to suit the attributes of the individual vehicle.

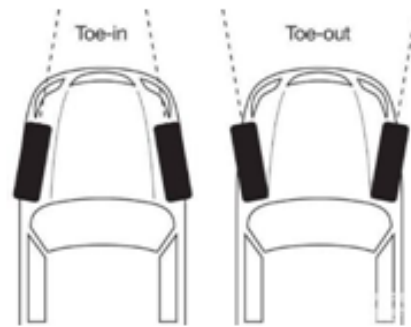


Fig 5: Toe In-Toe Out

IV. RESULT

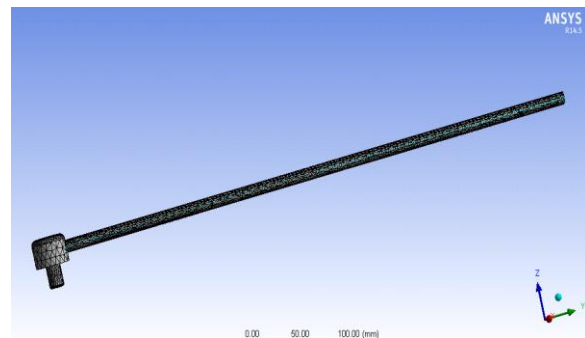


Fig 8: Tie Rod

V. CONCLUSION

Tie bar assumes essential job in directing framework and ought to be cautiously chosen. The led inquire about has started with making of 3D-CAD strong rough model as a multi-body framework, after that strong work will be created where every fit component thought to be flawlessly inflexible, and in definite phase of testing limited component investigation will performed utilizing Ansys programming bundle.

VI. FUTURE SCOPE

1. Static analysis can be done.
2. Transient analysis can be scope for further work.

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