Design and Analysis of Double Wishbone Suspension System For an ATV

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Abstract: This paper is mainly focused on design and analysis of double wishbone suspension system for an ATV by considering dynamically balanced conditions and by minimizing unsprung mass. 3-D cad model is prepared by using CATIA V5R20 for analyzing the system for all ride conditions. To provide greater travel, this allows better absorption of shocks during changes in ground conditions. Also this system is less expensive and lightweight. During off-road travelling, double wishbone system results into smooth motion and it avoid jerk and bump. Main objective of this project is to improve vehicle stability and comfort.

IndexTerms – Geometry of Double wishbone, Roll center, Dynamic parameters, Independent suspension.

I. INTRODUCTION
An ATV is supposed to have best of the suspension system than other categories of vehicles. So, suspension must be engineered in such way that it will provide the ability to complete every event with practical features like ground clearance and suspension travel, which will results in more comfort and control of an ATV for proper navigation. Double wishbone suspension system consist of two lateral control arms usually of unequal length. Upper arm is shorter than lower arm which induced negative camber. Camber change which helps in to keep contact path square on ground.

II. SUSPENSION SYSTEM
Suspension system is the system of mechanical linkages, spring, damper that is used to connect the wheels to chassis. Suspension of the vehicle keep the road wheel in contact with road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires.
While designing the suspension system all static and dynamic parameters such as forces, reactions from the ground, wheel alignment, kingpin inclination, scrub radius, ground clearance, roll center, etc. Besides this other factors considered in design are weight, cost, and availability of material.

III. TYPES OF SUSPENSION SYSTEM

3.1 Independent Suspension
An independent suspension permits wheels to rise and fall on their own without disturbing the opposite wheel that is motion of wheel pairs is independent, so that a disturbance at one wheel is not directly transmitted to its partner. Also it has better ride and handling.

Types of Independent Suspension:
1. Macpherson Strut
2. Double Wishbone
3. Trailing arm
4. Multi-link
5. Semi-trailing arm

3.2 Dependent Suspension:
Motion of a wheel on one side of the vehicle is dependent on the motion of its partner on the other side. Rarely used in modern passenger cars because it cannot give good ride and cannot control high braking and accelerating torques. Used in commercial and off-highway vehicles. E.g. Solid axle used in rear suspension of trucks.

3.3 Semi-dependent Suspension:
In this type, the motion of one wheel does disturb the position of the other but they are not firmly attached to each other. E.g. Trailing twist axle suspension.

IV. DOUBLE WISHBONE SYSTEM
The double wishbone suspension also known as A-arm suspension, is another type of independent suspension. It allows for more control over camber angle of wheel, which describes the degree to which the wheels tilt in or out. The main advantages of double wishbone suspension are its kinematic possibilities like camber, toe and other properties.

<table>
<thead>
<tr>
<th>Properties</th>
<th>AISI 4130</th>
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<tbody>
<tr>
<td>Carbon content (%)</td>
<td>0.30</td>
</tr>
<tr>
<td>Tensile Strength (MPa)</td>
<td>560</td>
</tr>
<tr>
<td>Yield Strength (MPa)</td>
<td>460</td>
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<tr>
<td>Hardness (BHN)</td>
<td>217</td>
</tr>
<tr>
<td>Cost (Rs./meter)</td>
<td>725</td>
</tr>
</tbody>
</table>

### 4.1 Stress Calculation
For ductile materials, allowable stress is obtained by the following relationship

\[
\sigma = \frac{S_{yt}}{f_s}
\]

Assume factor of safety, \( f_s = 2.5 \) (as AISI 4130 is ductile material).

\[
\sigma = \frac{460}{2.5} = 184 \text{ MPa}
\]

From geometry,
Length of upper arm = 14.08"
Length of lower arm = 16.02"  
Roll center = 14.28"
V. CAD MODEL

![Fig. 2. CAD model of Lower wishbone](image1)

![Fig. 3. CAD model of Upper wishbone](image2)

VI. ANALYSIS OF WISHBONE

![Fig. 4. Analysis of Lower wishbone](image3)
VII. CONCLUSION

- We have designed the double wishbone suspension and analyzed it on CATIA V5R20 Software where we found the safe result to desired condition of ride.
- We have calculated dimensions of upper and lower arm also we have calculated roll centre of ATV by geometry of double wishbone suspension system.
- We have predicted result of analysis of lower arm.
- We get maximum suspension travel, better performance and reduce cost and weight of suspension assembly; have been achieved.

REFERENCES