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DESIGN AND STATIC STRESS ANALYSIS OF DOUBLE WISHBONE SUSPENSION SYSTEM

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ABSTRACT

Suspension systems with double wishbones are by far the greatest option for sports cars. When compared to other suspension geometries, it is more stable and rigid. A short investigation of how a double-wishbone suspension system behaves under loading circumstances while travelling at high speeds is described in this paper, as well as the forces acting on its components and post-processed data. Solid Works is used to design the geometry of the whole suspension, and Ansys is used to do the analysis. The findings of the study are also examined using a variety of material selection and analysis techniques. Finally, when the values of Equivalent stress, Total Deformation, and Factor of Safety were assessed and found to be within threshold limits, the suggested suspension system was determined to be safe to use. Double wishbone suspension, static structural, suspension system, analysis, deformation, Ansys, stress analysis, FOS, FEA, structural analysis

Keywords: *double wishbone suspension, static structural, suspension system, analysis, deformation, Ansys, stress analysis, FOS, FEA, structural analysis*

1. INTRODUCTION

The suspension system of a car is both a basic and critical component; it keeps a stable grip on the vehicle and provides ride comfort even in the most difficult driving conditions. With the right tyre pressure, spring quality, and shock absorber, suspension may provide optimal comfort. A double-wishbone suspension system consists of helical compression springs, shock absorber struts, linkages, upper and lower control arms, steering knuckle, and wheel hub. This combination is based on the multiple needs of the vehicle [1]. The lower end of the spring and shock absorber arrangement is connected to the vehicle's lower arm (lower control arm), while the upper half is mounted to the chassis; this suspension system is suitable with most chassis structures.

The materials used in each component are also unique. This report includes a double-wishbone suspension since it is suited for a single-seater racing car because it maintains correct camber angle during corners. Because of its compact design and increased number of parts, it is stiffer and has less vibration. This suspension has a shorter construction, which lowers the centre of gravity, which is crucial in a sports car. This kind of suspension can also control torque steer. As a consequence, a new suspension geometry is developed using selected suspension materials.

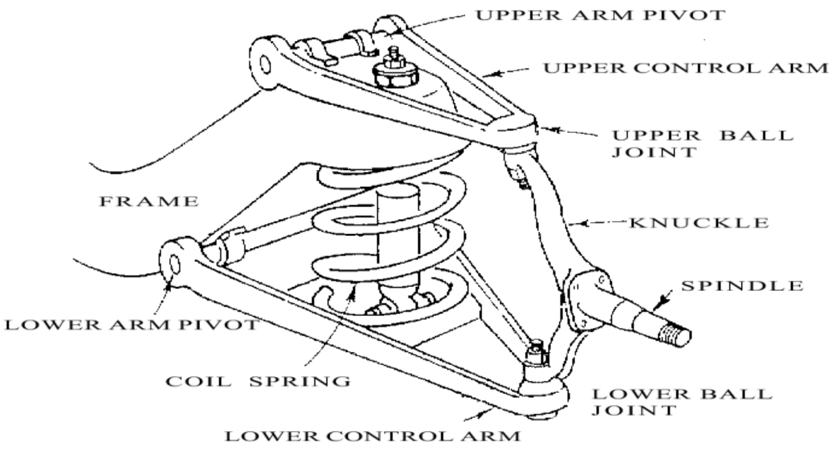


Figure1: double wishbone suspension

2. LITERATURE REVIEW

- **J. S. Hwang et al. [3]** has developed on how to detect the location of hard points using kinematic design of a double wishbone, which would improve vehicle stability.
- **Ramon Sancibrian et al. [4]** have attempted to use the multi objective dimensional synthesis approach to develop the kinematics of double-wishbone suspension systems in automobiles. Exact differentiation was used to create the Jacobian matrix, which was based on gradient determination using the synthesis technique.
- **N.Vivekanandan et al. [5]** Designing a double wishbone is a primary goal. Carbon content, tensile strength, yield strength, hardness, and cost were all considered in the material section. According to their research, AISI 1040 is the best material for wishbones. Suspension geometry and immediate centre of rotation concepts were used to determine the geometric roll centre.**R. C. Silva et al. [6]** seeks to offer computationally developed analytical equations for evaluating the double wishbone suspension in MATLAB. Their formula was developed using basic trigonometric techniques. The caster and camber angles are calculated using predefined points Cartesian coordinates (x, y, z) obtained from the CAD design as input to a formula.
- **Damodaran, P et al. [7]** have given an ideal dimensional synthesis of a five-link suspension mechanism in terms of link length and locations of the ten spherical joints fitted on the vehicle chassis and wheel carrier. The impact of the complaint joints on the suspension system's dynamic behavior is investigated. This optimization is done using the Mat lab optimization toolbox. The goal was to get the body's motion to the wheel carrier as near to a vertical translation as feasible in relation to the vehicle chassis.
- **Shijil P et al. [8]** a dynamic examination of the vehicle was conducted while it was driven on an off-road racetrack, and the parameter dynamic and static suspension systems of an ATV were studied. The ATV's performance is influenced by a number of factors. The emphasis of this study is on the design and analysis, as well as the determination and optimization of suspension systems and their optimal assembly performance. The goal was to discover and improve the factors that impact suspension system dynamic performance.

3. PROPOSED WORK

To create a Double Wishbone suspension system and perform FEA analysis by submitting the suspension model to the forces that would be anticipated while operating at high speeds and confirming your chosen material.

4. METHODOLOGY

The FEA process involves CAD modeling of piston in CREO design modeler. The model is developed as shown in figure 2 below. The model developed in CREO Simulation design modeler is imported for meshing in ANSYS.

Figure 2: Upper Wishbone

Figure 3: Lower Wishbone

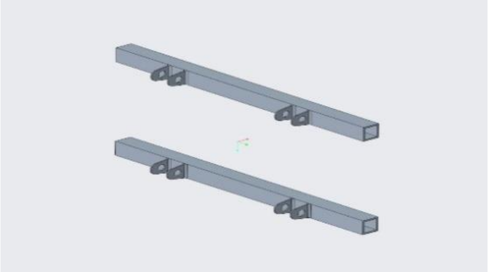


Figure 4: Chassis

Figure5: Spindle

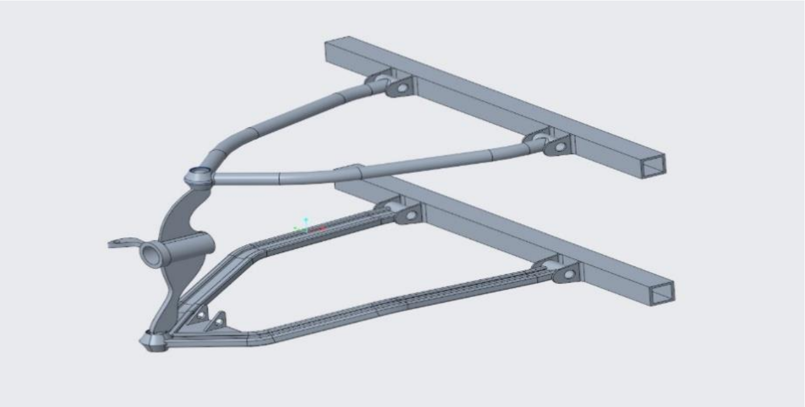


Figure 6: Complete Double Arm Suspension Model

The CAD model is meshed using tetrahedral components and exact scaling with curvature effects. The lower arm creates 14436 elements and 26202 nodes, while the spindle generates 3816 elements and 7813 nodes, as seen in the model above. The illustration displays the form of a tetrahedral element. It consists of four nodes connected by a tetrahedral form. The CAD model of the suspension is then applied with the relevant loads and boundary conditions after meshing.

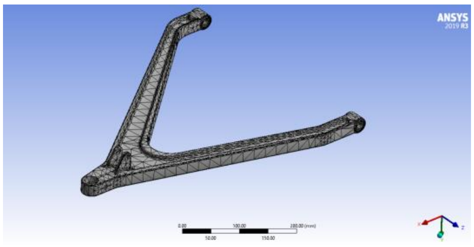


Figure7: Meshed Model (Lower Arm)

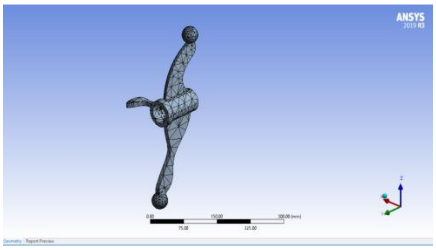


Figure 8: Model-2 Meshed (Spindle)

5. RESULTS AND DISCUSSION

The results of FE simulation are generated. The radial stress and tangential stress generated on piston is generated as shown in figure 6and figure7 below

Lower Arm (Structural Steel)

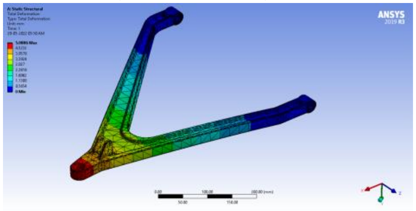


Figure 9: Total Deformation

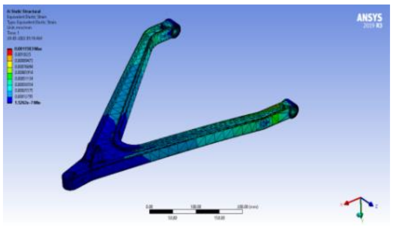


Figure 10: Equivalent Elastic Strain

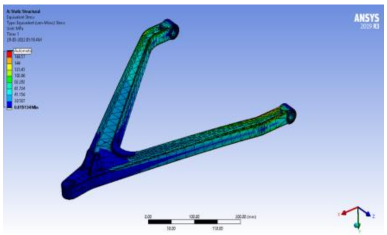


Figure 11: Equivalent Stress

Lower Arm (AISI 1010)

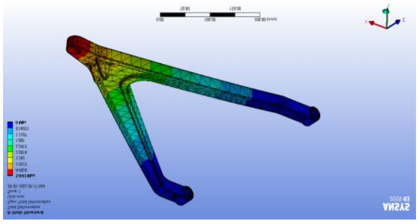


Figure 12: Total Deformation

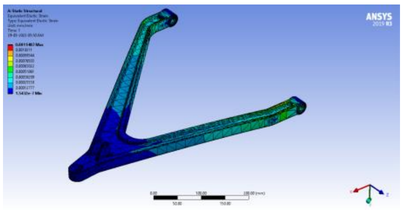


Figure 13: Equivalent Elastic Strain

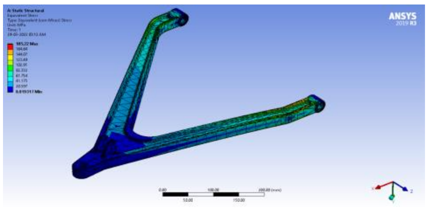


Figure 14: Equivalent Stress

Spindle (Structural Steel)

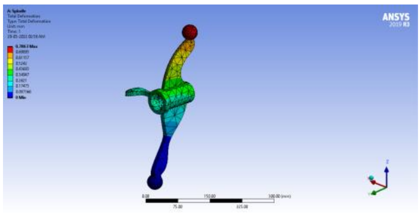


Figure 15: Total Deformation

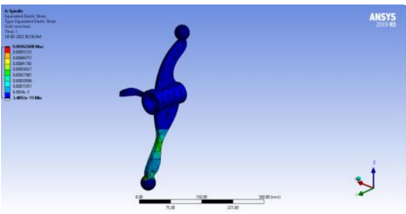


Figure 16: Equivalent Elastic Strain

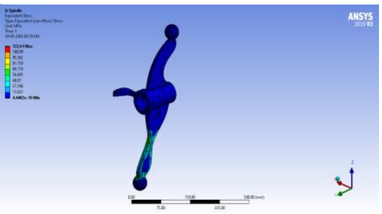


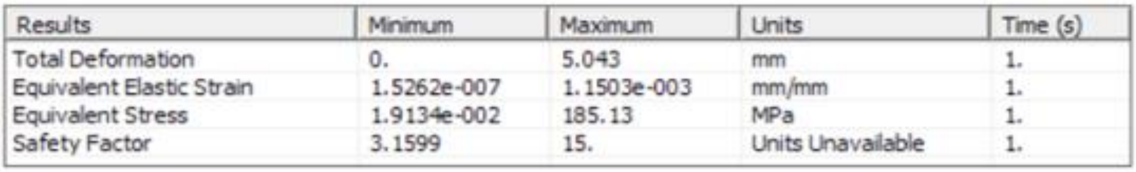
Figure 17: Equivalent Stress

Table 1: Model-1 Analysis Result

Table 2: Spindle Analysis Result

Results	Minimum	Maximum	Units	Time (s)
Total Deformation	0.	0.7863	mm	1.
Equivalent Elastic Strain	3.4892e-015	6.2688e-004	mm/mm	1.
Equivalent Stress	4.4482e-010	122.61	MPa	1.

Table 3: Lower Wishbone Analysis Result



Results	Minimum	Maximum	Units	Time (s)
Total Deformation	0.	5.043	mm	1.
Equivalent Elastic Strain	1.5262e-007	1.1503e-003	mm/mm	1.
Equivalent Stress	1.9134e-002	185.13	MPa	1.
Safety Factor	3.1599	15.	Units Unavailable	1.

6. CONCLUSION

After evaluating the data, it was discovered that AISI 1010 is better suited for A-Arm material since the component weight is optimised for the same FOS when using AISI 1010. However, subsequent investigation revealed that pipe with an outside diameter of 1 inch and a thickness of 2 mm is best suitable for this application, with a FOS of 1.8. For this purpose, it is projected that AISI 1010 inch outside diameter and 2 mm thickness will be used based on the data.

7. REFERENCES

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