Design and Analysis Of Knuckle Joint By Using FEA Structural Analysis Method

R.Sabariselvan[1], T.Veeramahendraprasath[2], S.Vishnu[3],R.Tamilvanan[4],P.Jeyaprakash[5].

[1,2]Assistant Professor, Department Of Mechanical Engineering, Cheran College of Engineering, K.Paramathi,KarurTamilnadu, India.rsabariselvan@gmail.com
[3,4,5] UG student, Department of Mechanical Engineering, Cheran College of Engineering, K.Paramathi,KarurTamilnadu, India.
maheerveera007@gmail.com,vishnu282001@gmail.com,tamil27vkl@gmail.com, jeyaprakashparamasivam66@gmail.com

ABSTRACT
Knuckle joints are connections between two parts that only allow motion in one direction. There are two rods connected by a hinged joint. Two rods with parallel axes are joined at the knuckle joint. Common applications include the connection between the steering rod and pinion on tractor trailers, roof truss tie rods, suspension bridge link joints, and steering systems. A mishap may occur if the knuckle joint fails. Therefore, the knuckle joint requires suitable design and analysis to withstand operational circumstances without failing. This concludes the modelling and study of the knuckle joint in a number of different states. A knuckle joint was modelled in CATIA and analysed using Finite Element Analysis (FEA). The problem was fixed using ANSYS version 15, a commercial finite element tool. Stresses in excess of 201 MPa are generated at the knuckle joint, whereas the highest allowable stress in 30C8 material is 400 MPa. The conclusion is that Design is safe. The research found that a 25mm pin could resist a 50KN strain without breaking.
Keywords: - Knuckle joint, FEA, ANSYS, CATIA.

1. INTRODUCTION

Joints play an important role in the mechanical and automotive sectors, and their permanence or transience depends on the application. Power transmission and motion transfer applications often use temporary couplings such the screwed joint, cotter joint, sleeve cotter joint, universal joint, or knuckle joint [1].

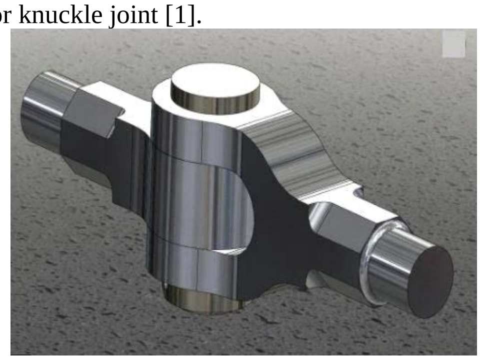

Figure 1. 3D View of Knuckle joint.

Knuckle joints are used in steering systems to connect the steering rod to the pinion of the steering gear. This is the only joint that will allow us to maximise plant output, since the lines of the action axes of both mechanical pieces cross and lie in distinct planes.

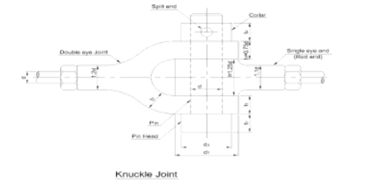

Figure 2. Sectional View of Knuckle Joint.

Figure 2 shows a cross-sectional image of a knuckle joint. The Knuckle Joint consists of the single eye, the fork (double eye), the knuckle pin, the collar, and the tapper pin. One of the rods has an eye at the end that fits into the fork's jaws, while the other rod is shaped like a fork. A cylindrical pin is placed through the fork and eye holes. A tapper pin, split pin, or tiny nut tightened against the pin's shoulder serves as a locator. The ends of the rods are octagonal so that they may be held securely. Load action usually occurs along axial or linear axes [2, 7].

One end of the rod creates a single eye, while the other end forms a pair of eyes. Each set of eyes, whether single or double, is joined by a tiny pin inserted into the pupil. There is a taper pin on one end of the pin and a head on the other. When separated, the pin holds the two eyes together. The solid rod part of the joint is much more sturdy than the hollow section the pin passes through. There are three possible causes of knuckle joint failure.

Shear failure of the pin 1 (Single Shear).

Second, the pin is squished by the rod.

#3: Flat-end bar breaks under tension.

It is important to build knuckle joints that can withstand load without failing since a failure might lead to an accident. Good design requires an understanding of the expected behaviour of a mechanical device or assembly. The designer had to calculate the loads placed on the system as it worked.

We know that pins are exposed to a lot of stress while they're functioning. Pins are utilised because they are a versatile, replaceable component. As a result, we may use pin for analysis. Then we use ANSYS software to examine the knuckle pin [8]-[10].

2. RELATED WORK

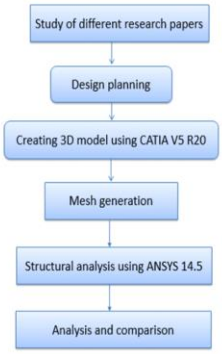

Figure.2. Methodology

3. MATERIAL PROPERTIES

As a result of graphite fractures, grey cast iron (also known as grey iron castings) takes on a bluish-grey colour and look when cast. What distinguishes grey iron from other forms of iron is the presence of graphite flakes, which form when the carbon in the iron crystallises out during cooling.

Grey iron is the outcome of the materials utilised as well as the casting technique. The components fused together to flow into the mould and the casting process both contribute to the resulting grey iron's varying properties (it is primarily the cooling part of the process that defines the characteristics of the cast part versus other parts of the process.).

Figure 3. Grey Iron Magnified to Show the Flakes of Graphite

As a result of graphite fractures, grey cast iron (also known as grey iron castings) takes on a bluish-grey colour and look when cast. What distinguishes grey iron from other forms of iron is the presence of graphite flakes, which form when the carbon in the iron crystallises out during cooling.

Grey iron is the product of both the raw ingredients and the casting process. The components fused together to flow into the mould and the casting process both contribute to the resulting grey iron's varying properties (it is primarily the cooling part of the process that defines the characteristics of the cast part versus other parts of the process.).

4. INTRODUCTION TO CAD/CAM/CAE

As a result of graphite fractures, grey cast iron (also known as grey iron castings) takes on a bluish-grey colour and look when cast. What distinguishes grey iron from other forms of iron is the presence of graphite flakes, which form when the carbon in the iron crystallises out during cooling.

Grey iron is the product of both the raw ingredients and the casting process. The components fused together to flow into the mould and the casting process both contribute to the resulting grey iron's varying properties (it is primarily the cooling part of the process that defines the characteristics of the cast part versus other parts of the process.).

ANSYS Workbench is a platform that combines simulation and parametric CAD systems with unparalleled automation and performance. The strength of ANSYS Workbench derives from years of expertise with ANSYS solver algorithms. In addition, the goal of ANSYS Workbench is to verify and improve the product in a virtual environment.

5. RESULT AND ANALYSIS

5.1. STATIC STRUCTURAL ANALYSIS OF STRUCTURAL STEEL KNUCKLE JOINT

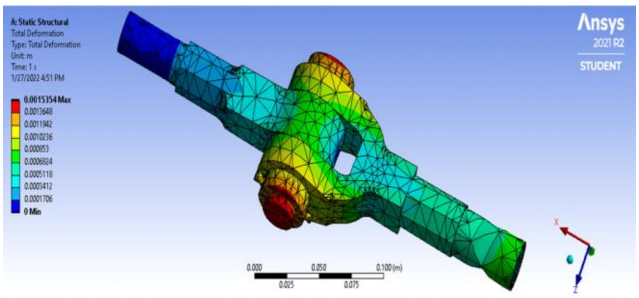

Figure 4. Total Deformation of Structural Steel Knuckle Joint.

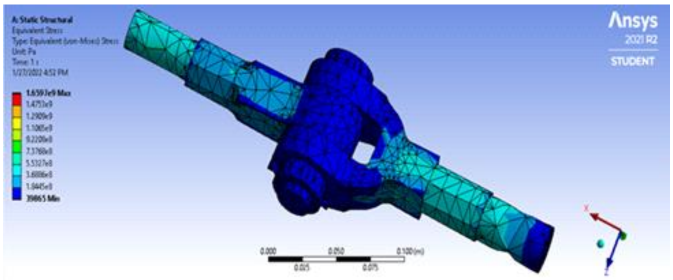

Figure 5. Equivalent stress of structural steel knuckle joint

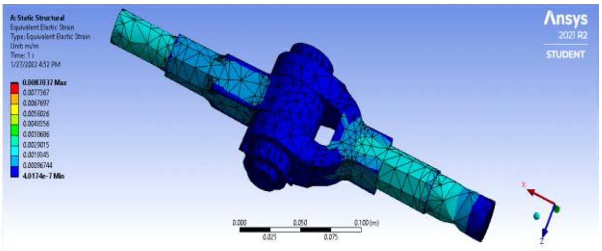

Figure 6. Equivalent elastic strain of structural steel knuckle joint

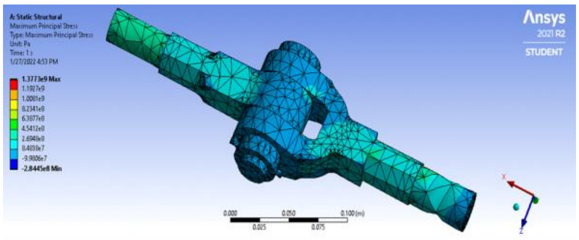

Figure 7. Max principal stress of structural steel knuckle joint

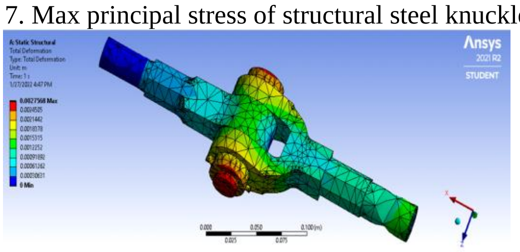

Figure 8. Total deformation of greycastiron knuckle joint**.**

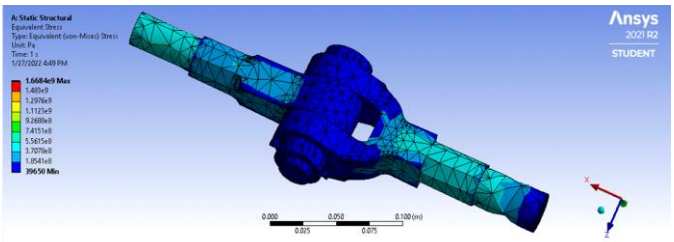

Figure 9. Equivalent stress analysis of greycastiron knuckle joint.

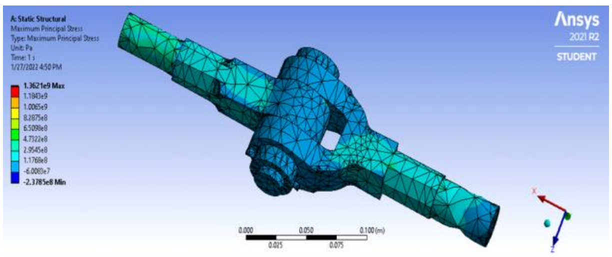

Figure 10. Maximum principal stress of greycastiron knuckle joint.

STATIC STRUCTURAL ANALYSIS OF ALUMINIUM KNUCKLE JOINT

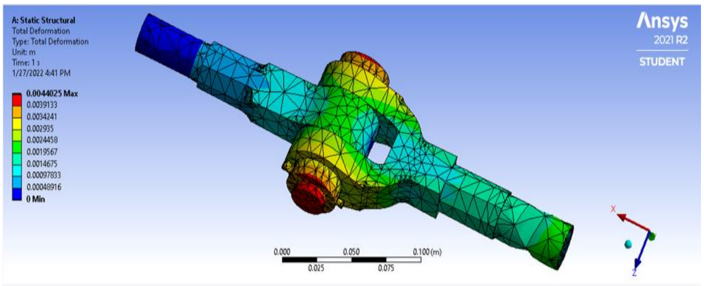

Figure 11. Total deformation of aluminium knuckle joint.

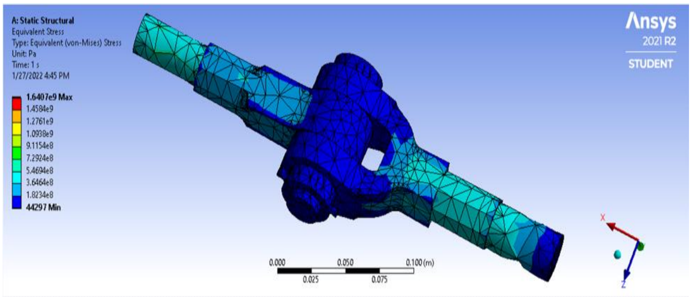

Figure 12 . Equivalent stress of aluminium knuckle joint.

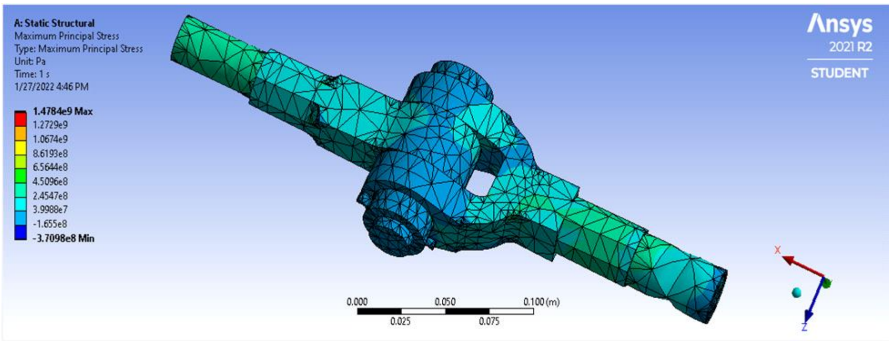

Figure 13. Max principal stress of aluminium knuckle joint.

6. CONCLUSION

The results reveal that the knuckle joint may be built and optimised to withstand a wide variety of loads, including both compressive and tensile loads. By using alloys, the knuckle joint's weight might be reduced. The analytical findings suggest that the alloy material combined with structuralsteel performs better than the alternatives. Connecting rods made from the latest generation of optimised alloys are much more rigid than their predecessors.

7. REFERENCES

1. vinaypatal , mahajan, “A Static Structural Analysis Of Knuckle Joint Used For Sugarcane Mill”.
2. Swati Datey , Amit A. Rangari, “Analysis Of Knuckle Joint Used In Mahindra 575 Dl”.
3. SouravDas ,VishvendraBartaria, “Analysis Of Knuckle Joint Of 30c8 Steel For Automobile Application”.
4. G. Sailaja, “Analytical And Numerical Analysis Of Knuckle Joint By Using Different Materials”.
5. Sajidkhan, “Design And Stress Analysis Of Knuckle Joint Of Different Material Using Cae Tools”
6. Ritvik Bhardwaj, “Design And Analysis Of Knuckle Joint For Different Materials”.
7. John basha , “Modeling And Analysis Of Knuckle Joint”.
8. Mrs. SayliM.Sable, “Static Structural Analysis Of Knuckle Joint”.
9. Sangamesh B. Herakal, “Structural Static Analysis Of Knuckle Joint” .
10. NishantVibhavSaxena “Study & Analysis of Knuckle Joint with the Replacement of Material by Using Teflon”.