
Design and Analysis Of Universal Joint

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ABSTRACT

The rapid development of technology over the last several decades has decreased the price of materials and made them lighter. The adapted strategy is widely used in academic and corporate settings. Due to this, both the number of accidents and the overall level of safety have decreased. Universal joints are used in many industrial systems and are constructed from structural steel, magnesium, and copper. It is proposed that cast iron be modified into a composite polymer material. The proposed approach has several advantages over existing systems, such as its potential to reduce complexity, guarantee the highest level of safety, and minimise negative effects on the environment. The study of the system shows that all of the required qualities are met, and that the universal joint is well-designed and well-analyzed enough to withstand normal operating circumstances without failing. Because of this, modelling and analysis of universal joints under specified circumstances are carried out. The universal joint was modelled in CATIA 3D software, and then analysed using Finite Element Analysis (FEA). Polymer is being considered because its characteristics are so close to metal that it may be mistaken for it. Composite polymers may be formed in many different ways. Because of technical advancements made in the previous year, stress and anxiety levels have decreased.

Keywords: Universal 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 nature of the task at hand. Power transmission and motion transfer applications often use temporary joints such bolted joints, cotter joints, sleeve cotter joints, universal joints, and universal joints. The steering rod and pinion of the steering gear are connected through a universal joint. It is the only possible connection between the two mechanical parts since their action axes cross and lie on different planes. Maintaining a flexible approach to manufacturing technologies is essential for the plant to operate at peak efficiency [1]-[5]. A universal joint is used to unite two rods that will be subjected to tensile stress. This joint can accommodate for some angular misalignment between the rods and, if used correctly, can even tolerate some compressive force. These joints are used for a variety of applications, including tie rods and tension links in bridge construction. Both the forked end and the unforked end of one of the rods have eyes on them. A pin (universal pin) is placed through the rod-end and fork-end eyes, and is secured with a collar and a split pin. It is crucial to design universal joints that can withstand strain without failing [6]-[10] due to the potential for accidents if a universal joint fails.

2. INTRODUCTION TO UNIVERSAL JOINTS

When two cylindrical rods with parallel axes need to be joined together, a universal joint is the mechanical coupling of choice. A little amount of rotational freedom is provided by the space between the cylindrical rods (in their plane). Tensile strength is a design priority, thus it was constructed accordingly. A mechanical connection between two intersecting spinning shafts is called a universal. They may represent speed, strength, or both. The Yoke Joint, sometimes called a Hooke Joint, is the most common and easiest kind of joint. You may see the condition shown in Figure 1. The Spider, an intermediary device in the form of a cross, connects the two yokes on the shafts. The angle created by the two shafts is known as the operational angle. The flexibility of the joint is achieved by the use of two U-shaped yokes joined by a cross-shaped hub. With the U-sections at right angles to one another, one yoke is secured to the distal portion of the split shaft and attached to the cross hub. The widespread usage of this material in vehicles such as automobiles, buses, and trucks has brought it widespread recognition.



Figure.1. Universal Joint

A typical universal joint has the following parts

1. Fork end
2. Eye end
3. Universal pin
4. Collar

3. RELATED WORK

Softwares used :CATIA, ANSYS

CATIA Definition : CATIA (Computer Aided Three Dimensional Interactive Application) is a multi platform software used for computer aided design and manufacturing and 3D modelling of a product.

ANSYS Definition : ANSYS is a general purpose, finite element modelling package for numerically solving a wide variety of mechanical problems. ANSYS has been found at the year 1970 and it is incorporated in the year 1994.

4.METHODOLOGY

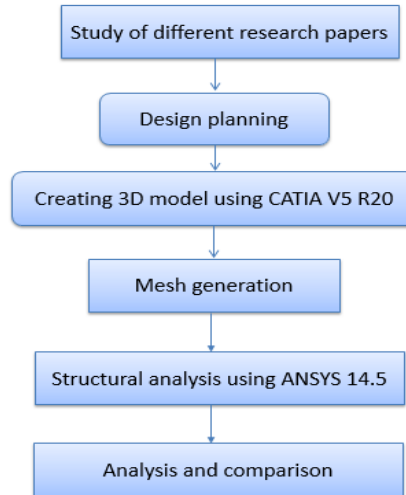


Figure.2. Methodology

5. GREY CAST IRON

Castings made from this kind of iron, which gets its distinctive grey hue from the presence of graphite, are known as grey cast iron. The graphite flake structure created by the carbon in grey iron after cooling sets it apart from regular iron.

Grey iron is the product of both the chemicals used and the casting process. Simply defined, the properties of grey iron are set by the combination of components and the method they are cast (it is primarily the cooling part of the process that defines the characteristics of the cast part versus other parts of the process.).

Under a powerful microscope, the graphitic microstructure of grey iron, which allows it to be easily identified, becomes visible. Gray iron castings can have tiny black graphite flakes embedded inside them. These flakes cause the material to fracture and take on a grey hue. Mechanical properties of grey iron, which may be tested using ASTM standards, are determined by the size and shape of graphite flakes present in the microstructure.

More grey iron castings than any other kind of casting are produced each year. Disc brakes on your automobile and almost all manhole covers are likely made of grey iron. The following are some more applications for grey iron: Gears

Fluid power: hydraulics

Suspensions for automobiles

Equivalent shares of the plough

Pumps

Linkages

Components for Cooking Appliances

Chopsticks for the wheel

Agriculture machinery and equipment components

Valves

Suspension parts for trucks

Extra truck components

Cases for wind generators.

There are both weights and counter-weights.

Fabrication of a solid foundation for heavy machinery.

Although it has the same compressive strength as low and medium carbon steel, grey cast iron is weaker in tensile strength and more easily damaged by shocks than other castings and even steel. These mechanical properties are set by the size and shape of the graphite particles in the microstructure.

Table.1. Composition Of Grey Cast Iron

Iron Family	Grey	Ductile	CGI	Malleable	White
Carbon	2.5-4.2	3.0-4.0	2.5-4.0	2.2-2.8	1.8-3.6
Silicon	1.0-3.0	1.8-3.0	1.5-3.0	1.2-1.9	0.5-2.0
Manganese	0.15-1.0	0.1-1.0	0.10-1.0	0.15-1.2	0.15-0.8
Sulfur	0.02-0.25	0.01-0.03	0.01-0.03	0.02-0.2	0.02-0.2
Phosphorus	0.02-1.0	0.01-0.1	0.01-0.1	0.02-0.2	0.02-0.2

Aluminum (chemical symbol: Al, atomic number: 13) is a member of the boron group of elements. It's a white metal that bends and shapes easily and is rather malleable. After oxygen and silicon, aluminium is the most common metal in the Earth's crust. It accounts for around 8% of the mass of the Earth's crust.

Natural aluminium specimens are very rare and can only be discovered in extremely decreasing environments. On the other hand, it might be present in over 270 different minerals. The mineral bauxite is the primary source of aluminium production.

Description

Aluminum is unique due to its low density and the phenomenon of passivation, which makes it corrosion-resistant. Aluminum and its alloys are widely used for manufacturing aircraft and transportation industry structural components. Aluminum oxides and sulphates are the most practical aluminium compounds.

Aluminum salts are widespread in nature, yet no known organism can use them metabolically. Because of its widespread presence, it is not surprising that plants and animals tolerate aluminium well. Because aluminium compounds are so ubiquitous, researchers are always curious about their potential beneficial or harmful effects on living organisms.

Structural steel is a type of steel that is fabricated into many different types of construction hardware. Many structural steel shapes have the form of an extended beam with a predetermined cross section profile. Most industrialised countries have established norms for structural steel that regulate its shape, size, chemical make-up, mechanical properties (such as strength), storage methods, and so on.

Most I-beams and other structural steel designs have large second moments of area, which means they are quite rigid and can support a lot of weight without bowing.

Table.2. Properties Of Aluminium

1.	Molecular formula	AL
2.	Atomic Number	13
3.	Element category	other metal sometimes considered a metalloid
4.	Odour	Odourless
5.	Standard atomic weight	26.9815385
6.	Density	2.70 g•cm ⁻³
7.	Melting point	933.47 K, 660.32 °C, 1220.58 °F
8.	Boiling point	2743 K, 2470 °C, 4478 °F
9.	Solubility in water	Insoluble
10.	Solubility	insoluble in diethyl ether, practically insoluble in ethanol
11.	Thermal conductivity	237 W•m ⁻¹ •K ⁻¹
12.	Young's modulus	70 GPa
13.	Shear modulus	26 GPa
14.	Bulk modulus	76 GPa
15.	Micron size	200 mesh (74µm)
16.	Poisson ratio	0.35

6. WORKING PRINCIPLE

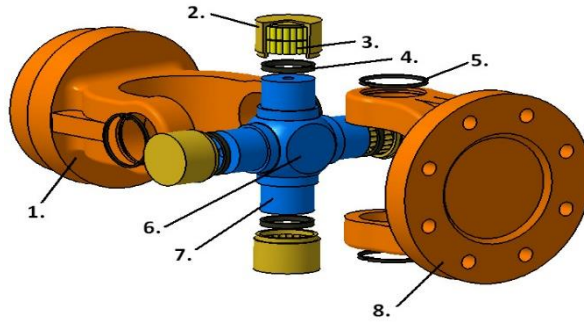


Figure.3. 3D model of universal joint



Figure.4.. Universal joint coupled with shaft

The universal joint is designed to allow the angle between the connected components to change within a predetermined range, much like the joints in a human leg. To accommodate and meet the power produced by the car's running variations due to the Angle, the axle shaft of front-wheel-drive vehicles is often attached to a shared universal joint between the wheels and the axle. Constant speed universal joints are often used to reduce vibration, wear on moving parts, and noise pollution, but a single universal joint cannot make the output shaft and the shaft entering the shaft of the instantaneous angular velocity are identical. This is because of limitations in axial size. Each half shaft, prior to the introduction of drive motor vehicles, used two patterned constant speed universal joints: one within the universal joint near the transaxle and another inside the universal joint near the lateral axle. The drivetrain of a rear-wheel-drive vehicle, comprising the engine, clutch, and gearbox, is installed in a rigid mounting bracket and connected to the frame and drive axle through flexible suspension. Drive a car powered by a double universal joint, which is to have a universal joint on both ends of the transmission shaft, its role being to make the shaft ends of equal Angle, so as to guarantee the instantaneous anguish. This is because the gearbox output shaft and the Angle between the drive axle and the main reducer input shaft can change depending on the road surface, the amount of weight being transferred, and the number of assemblies installed.

7. RESULTS

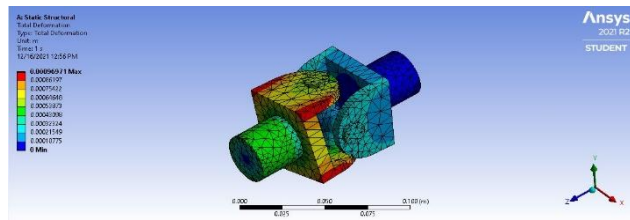


Figure.5. Total deformation of structural steel universal joint

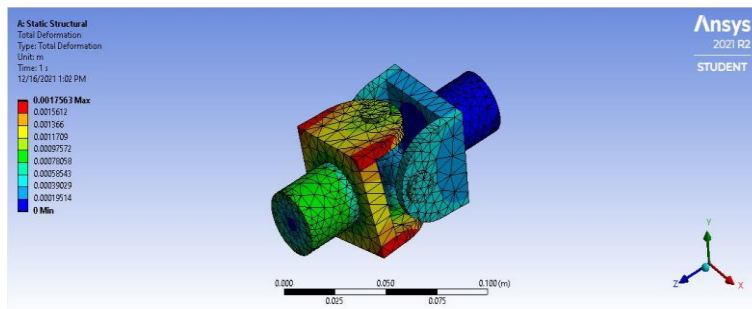


Figure.6. Total deformation of Grey castiron universal joint

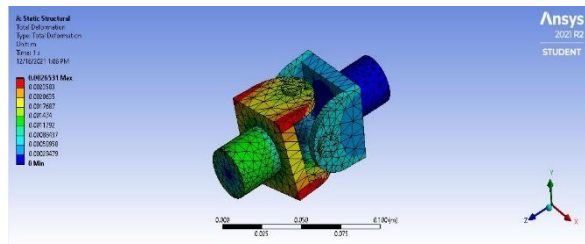


Figure.7. Total deformation of aluminium universal joint

8. CONCLUSION

These three images from ANSYS depict testing performed on steel, greycast iron, and aluminium. Values in the analysis reports vary, despite their seeming similarity. .

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