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DESIGN, PROTOTYPING AND ANALYSIS OF MODIFIED UNIVERSAL COUPLING

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Abstract : *A coupling is a mechanical device that can transmit a power or rotational motion from one shaft to another shaft at fixed and varying angles of intersection of the shaft axis. Here a Re-design of universal coupling which allows power transmission between two misalign axis is carried out. The main motive of modified universal coupling is to join two shafts of rotating equipment while permitting some degree of misalignment. In normal universal coupling there is a possibility of power transmission through a maximum angle upto 30°. As compared to existing design, modified universal coupling permits maximum angle upto 60° . In this project the three dimensional model of modified universal coupling is created using UNIGRAPHICS software and prototype is developed by using RAPID PROTOTYPING technique and analysis to be done in ANSYS 19.2 WORKBENCH software to analyse the total deformation, equivalent(von-mises)stress.*

Key Words: UNIGRAPHICS software, Prototype, ANSYS software

1. INTRODUCTION:

The power produced from an engine of automobile can be transferred to the drive wheel by power transmission system. To transmit the driving torque from the engine or gear unit to the final drive by the propeller shaft, we need at least one or two universal couplings. A coupling is used to connect two shafts together at their ends for the purpose of transmitting power. By careful selection, installation and maintenance of couplings, substantial savings can be made in reduced maintenance costs and downtimes.

Dhananjay S Kolekar [1], This paper contains the design of modified yoke and existing yoke, By creating physical prototype of modified yoke and typical test setup for physical experiment. Software analysis of existing yoke.

J Ramesh [2], This paper describes, creating the design in 3D model by using CATIA software and structural analysis has been performed on the universal joint by using ANSYS software.

Maram Venkat Sunil Reddy [3], this paper contains the Design and analysis of universal coupling joint.

Purvesh Shah [4], this paper describes the analysis of Existing design and modified design assembly of universal coupling.

P Chennakesava [5], this paper describes the fabrication of 3D parts or components by using Fused deposition modeling technique.

Thabisco Peter Mpofu [6], This paper contains the impact and applications of 3D printing technology.

1.1 TYPES OF COUPLINGS

1. Rigid couplings
2. Flexible couplings

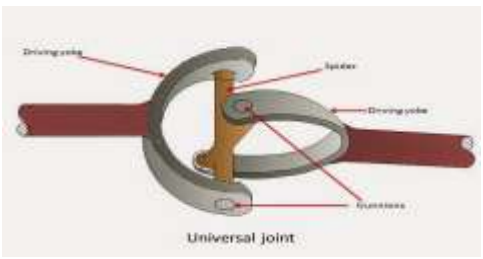
In the rigid couplings there is no chance for transmission of power in misalignment.

In flexible couplings, is also possible for transfer of power in some angles from driving shaft to drive shaft upto 18°

1.2 FLEXIBLE COUPLING

HOOKE'S JOINT

It is a kind of universal joint. It is often used to transmit rotary motion from one shaft to another shaft when they are not coaxial ie, when their axes are inclined to each other. It has two U-shaped yokes and a cross trunnion. The cross trunnion is used to deliver rotation from one yoke to another by using four needle pin bearings.



2. OBJECTIVES:

The main aim of this project is to Design a new coupling in UNIGRAPHICS software and developing a prototype by using Fused deposition modeling. In this project, only the static FEA of the modified universal coupling has been performed by the use of analysis software. To determine the total deformation and Equivalent (von-mises)stress. Analysis can be performed by using two different materials structural steel and stainless steel. Comparision of analytical results with each other.

3. INTRODUCTION TO UNIGRAPHICS SOFTWARE:

Unigraphics NX (Also known as Siemens NX) is a high end, next generation, tightly integrated CAD/CAM/CAE product development software owned by Siemens PLM software. We can draw 2D and 3D models of a section and in like manner the gathering of the parts should be possible in it.

Siemens NX is a flexible and powerful integrated product development solution that helps to deliver innovative products faster and more efficiently.

FEATURES OF NX

1. Synchronous modeling
2. Feature-based modeling
3. Parametric modeling

MODEL IS DRAWN:

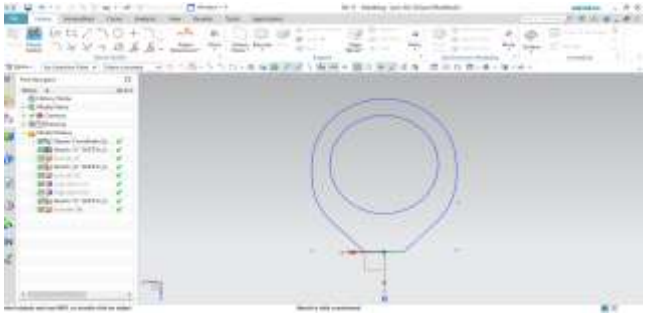


Fig -1: Sketch view

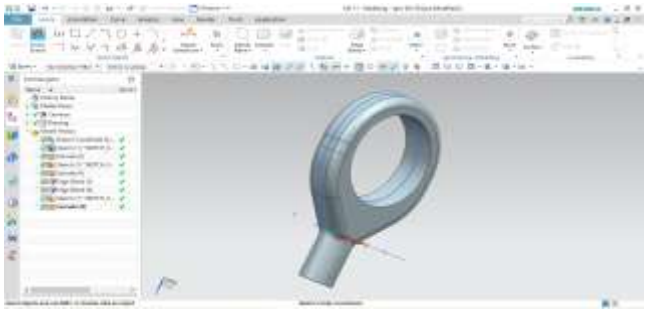


Fig -2: 3d view

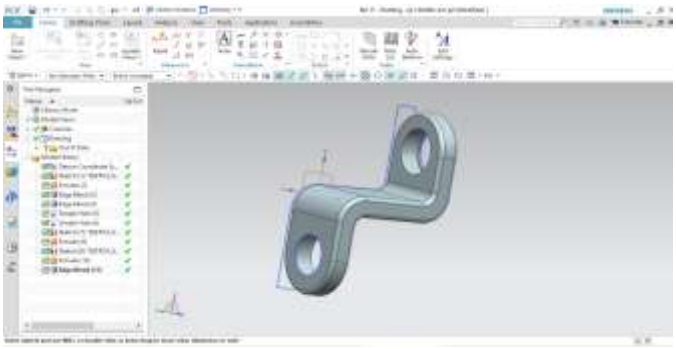


Fig -3: Z-shape coupler

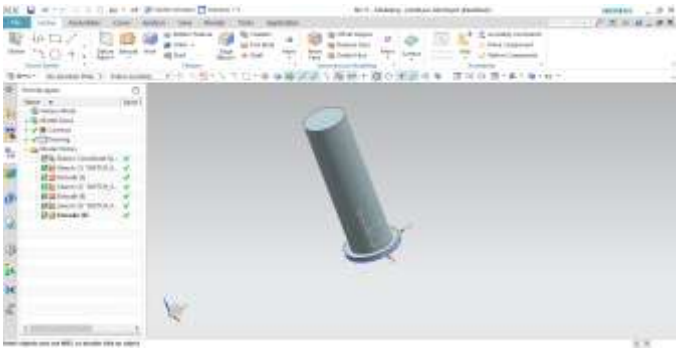


Fig -4: pin

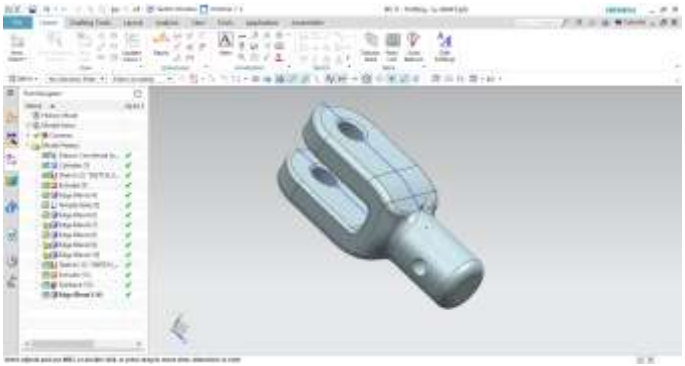


Fig -5: fork end

Fig -6: Assembly view of modified universal coupling

4. RAPID PROTOTYPING:

Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three dimensional computer aided (CAD) data. Construction

of the part or assembly is usually done using 3D printing or "additive layer manufacturing" technology.

4.1 RAPID PROTOTYPING TECHNIQUES

1. Stereolithography (SLA)
2. Selective laser sintering (SLS)
3. Fused deposition modelling (FDM)
4. Selective laser melting (SLM)
5. Laminated object manufacturing (LOM)

4.2 FUSED DEPOSITION MODELING

Fused deposition modeling (FDM) is a type of additive manufacturing technology that enables the construction of 3D objects, prototypes and products through a computer-aided or driven manufacturing process. FDM also known as fused filament fabrication method.

4.3 MATERIALS UESD IN MAKING (FDM) PARTS

Most of the existing FDM machines use thermoplastic materials which are in filament form for the extrusion and deposition purpose. Polylactic acid (PLA) is a one type of material and its temperature (190°–210°c). Acrylonitrile butadiene styrene (ABS) and its temperature used in FDM is (180°c)

4.4 STEPS TO BUILD A MODEL:

1. We have created a CAD model of modified universal coupling by using UNIGRAPHICS software.
2. Save it in the Stereolithography(STL) file format.
3. Load the stl file in to the slicing software or the interface platform between the specific machine and the computer.
4. Upload the sliced file into the FDM machine.
5. Run the machine with required settings.
6. Detach the parts from the table after completion of printing process.

In this project we use polylactic acid (PLA) material to fabricate the parts of modified universal coupling. PLA is made from renewable resources such as corn or sugar cane, it's a natural polymer designed to substitute widely used petroleum-based plastics like PET (polyethene terephthalate).

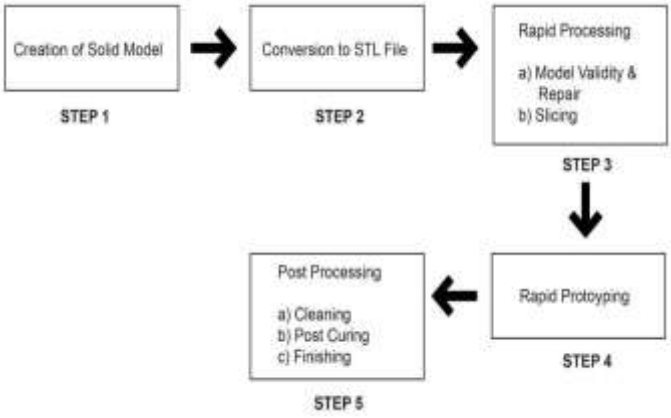


Fig -7: printing process flow chart

4.5 FABRICATION BY (FDM)

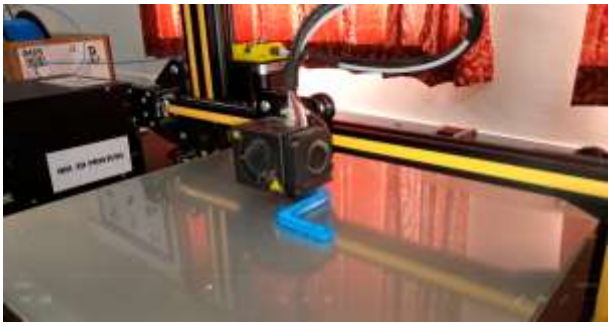


Fig -8: fabrication of Z shape coupler

Fig -9: fabrication of fork ends

Fig -10: finished products

Fig -11: assembly view of modified universal coupling

Fig -12: overall assembly with some angle

5. ANALYSIS:

FINITE ELEMENT ANALYSIS (FEA)

The finite element method is the most widely used method for solving problems of engineering and mathematical models. The analytical method is used for the regular sections of known geometric entities or primitives where the component geometry is expressed mathematically. The solution obtained through analytical method is exact and takes less time.

5.1 INTRODUCTION OF ANSYS

Ansys is a general purpose finite element modeling package for numerically solving a wide variety of mechanical problems. In workbench, the user can generate 3D and FEA models, perform analysis, and generate results.

5.2 STATIC STRUCTURAL ANALYSIS

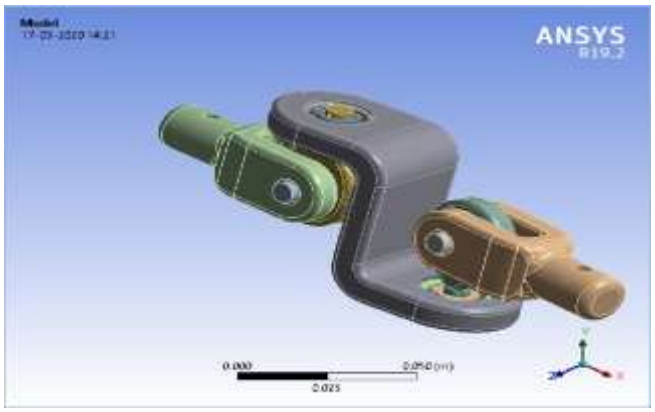
Structural analysis is the determination of the effect of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads.

5.3 SETUP

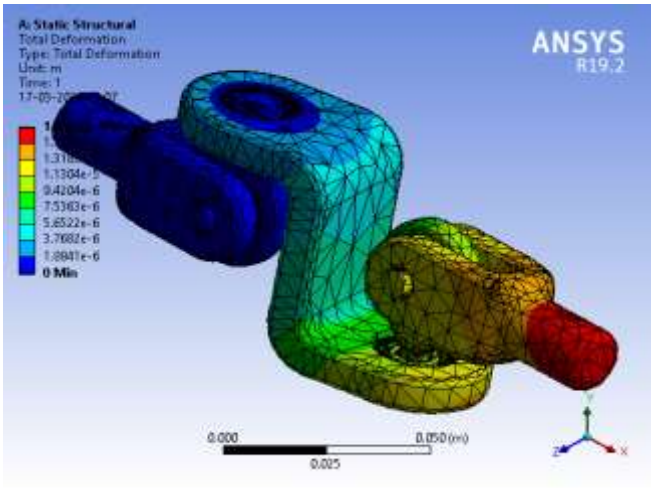
1. One fork is to be taken as fixed support.
2. Another fork has rotational velocity (2000rpm) in x direction either clockwise or anticlockwise.

IMPORTING THE MODEL:

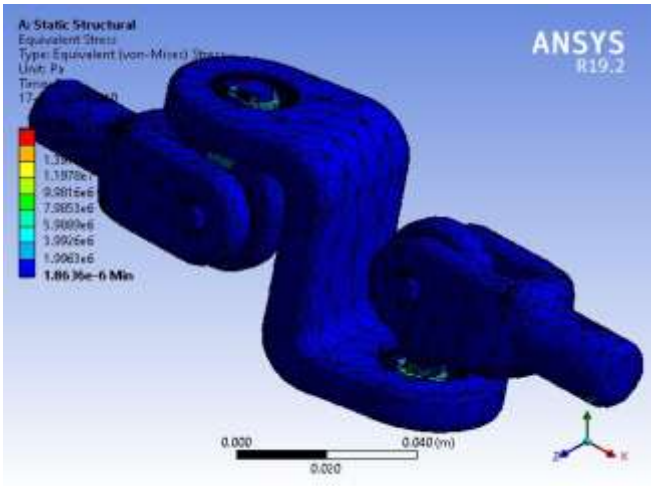
In this step UNIGRAPHICS model is imported into ANSYS 19.2 workbench



FOR STRUCTURAL STEEL:

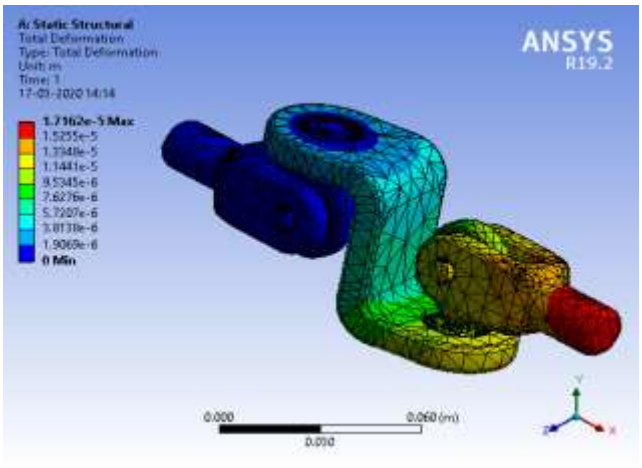


Total deformation

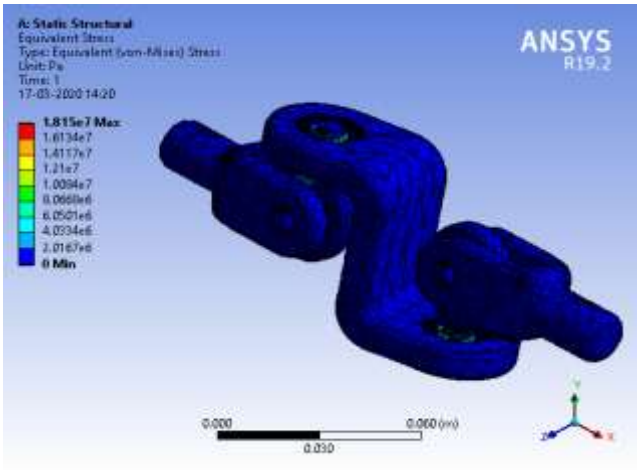


Equivalent stress

FOR STAINLESS STEEL:



Total deformation



Equivalent stress

Comparison of results for static structural Analysis

Material	Total deformation (mm)	Equivalent stress (n/mm^2)
Structural steel	0.016957	1.7967e+007
Stainless steel	0.017162	1.815e+007

6. ADVANTAGES OF THIS PROJECT

1. It gives more flexibility.
2. Maximum possible angle of power transmission is 0°-60°
3. It is easy to design, manufacturing and assemble.

7. CONCLUSIONS

By performing this project we have learn the design and analysis of a modified universal coupling. We have designed the part design in 2D and 3D models and do assembled. Also we create a prototype of this model for physical experience. Structural analysis is done for finding the results of total deformation, equivalent stress. Analysis was done by considering two different materials structural steel and stainless steel. In this aspects structural steel having less deformation compared to others. This analysis describes the structural steel is good material for this design. In future it will be helpful for us to choose the right coupling among various types of couplings.

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