ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

MODELLING AND ANALYSIS OF RIGID FLANGECOUPLING

P.Lavanya,S. Madhu, S.Vijay Rohith & S.Bhanuchandar
Under the esteemed guidance of
Mr. M.Raghava Rao, M.Tech, (Ph.D)
Associate professor
Department Of Mechanical Engineering,
AvanthiInstitute Of Engineering & Technology

ABSTRACT

A Coupling is a device which is responsible for the operative power transmission between two shafts rotating at particular RPM. Coupling is used to connect two different shafts at their end and can slip or fail depending upon the torque limit. It is the crucial part of any power transmission and may last for very long time if designed and maintained properly.

The present study of this project is to reduce the stress that acting on the bolts by making it uniform strengthens. The stress in the threaded part of the bolt will be higher than that in the shank. Hence a greater portion will be absorbed at the region of the threaded part which may fracture the threaded portion because of its small length. The main aim of this project is to reduce the maximum shear stress by selecting a suitable material for flange coupling by comparing between the materials that has been asssigned to the coupling during analysis process.. The analysis is conducted to verify the best material for the Bolts and Nuts in the Rigid Flange Coupling at higher speeds by analyzing stress, displacement and also by considering weight reduction.

The analysis is done in ANSYS WORKBENCH software. Modeling is done in the CATIA V5 R22.

CHAPTER-1

1. INTRODUCTION

Shaft couplings are devices that connect two shafts to transmit power from a driveshaft to a driven shaft while absorbing some degrees of misalignments and mounting errors between the two shafts. Misalignments exist between two shafts as a result ofthe changes in temperature and deterioration of positioning accuracy over time. Shaft couplings provide mechanical flexibility to allow smooth rotation between the shafts and reduce impact, wear, vibration, noise, and risk of equipment failure.

Figure 1:SHAFT COUPLING

Cite this article as: P.Lavanya,S. Madhu, S.Vijay Rohith & S.Bhanuchandar & Mr.M.Raghava Rao, "Modelling And Analysis Of Rigid Flangecoupling", International Journal & Magazine of Engineering, Technology, Management and Research (IJMETMR), ISSN 2348-4845, Volume 10 Issue 4, April 2023, Page 1-9.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Shaft couplings are commonly utilized in mechanisms requiring transmission of power involving equipment like motors, generators, pumps, compressors, turbines, engines, and machines. There is a wide array of shaft coupling types for a variety of operating conditions. The main classifications of shaft couplings are rigid shaft couplings and flexible couplings, which will be discussed in detail in the succeeding chapters.

With connected machines, the design of a flexible shaft involves trade-offs regarding how much offset can be acceptable for fatigue life and how high the rotational speed can be before running into the first bending frequency or whirling, which can be destructive and is what the majority of designs stay below. There are frequencies that operate above the first bending frequency but use snubbers to limit radial excursions. In most applications, the first axial bending frequency happens first. When the operational speed is above it, the potential of damage is much less.

CHAPTER-2
2. LITERATURE REVIEW

2.1 INTRODUCTION TO RIGID COUPLING:

Rigid couplings are a type of coupling that should onlybe utilized when shafts are precisely in line. A rigid coupling is only suitable for shafts in close alignment or held in alignment. If not aligned, torque will transfer to the shafts and bearings and likely cause premature failure. Unlike most other types of couplings, there is no flexible element in a rigid coupling there is no flexible element in a rigid coupling.

There are three main types of rigid couplings: sleeve, flanged and clamped. For commercial shafting, a rigid coupling may be a sleeve with the shafts pressed into each end or it may be a clamping sleeve. The sleeve on each shaft end may have an external flange with bolt holes. Couplings for large power machines are bolted together to hold the shafts rigidly; therefore the shafts must be accurately aligned before assembly.

Figure 1: Rigid Coupling

Rigid couplings are characterized as belonging to oneof the following categories:

2.2 Flange Coupling:

Flange couplings are widely used rigid couplings to connect shafts of the same or different diameters. The flange-style couplings consist of two separate flanged hubs, bored and keyed to fit their respective shafts andjoined by bolted pattern. On one flange there will be a projected part called a pilot or spigot on the other flange there will be a corresponding recess to make the perfect alignment for both flanges. Some may includeremovable bushing or spacer to allow for the removalof a mechanical seal and easier replacement.

Usually are made of carbon steelAvailable to

over 8” in diameter

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Mostly designed for heavy-duty applications

Can be used on the large shafts **Figure5: Flange Coupling**

Suitable for alignment accuracy, for example, marineapplications

The gasket is used to eliminate leakage

These couplings can be helpful to bring the shaft to maintain the alignment and are also capable to adopt heavy loads. Flange couplings are normally utilized in pressurized piping systems and funneling frameworks where two pipes or tubing closes need to meet up.

Figure 2.1: Flange Coupling

CHAPTER-3

3. INTRODUCTION TO CAD

Computer-aided design (**CAD**), also known as **computer-aided design and drafting** (**CADD**), is theuse of computer technology for the process of design and design-documentation. Computer Aided Drafting

describes the process of drafting with a computer. CADD software, or environments, provide the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic- based software utilizes raster-based (pixelated) environments.

3.1 INTRODUCTION TO CATIAV5 R20:

CATIA Wildfire is the standard in 3D product design, featuring industry-leading productivity toolsthat promote best practices in design while ensuring compliance with your industry and company standards. Integrated CATIA V5CAD/CAM/CAE solutions allow you to design faster than ever, while maximizing innovation and quality to ultimately create exceptional products.

The main modules are**Part Design Assembly**

Drawing

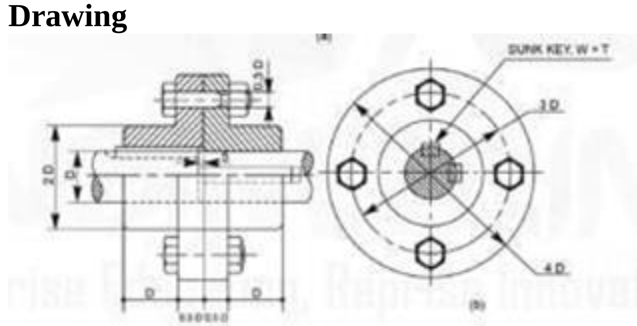

Figure 3.1:Design Of Flange And Hub

3D MODELING:

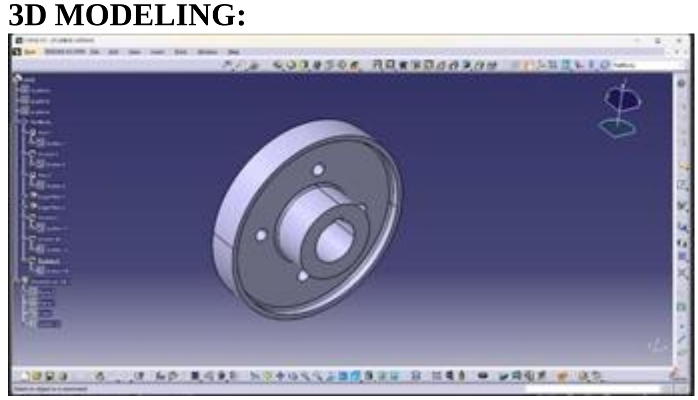

Figure 3.2: FLANGE WITH HUB PART

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

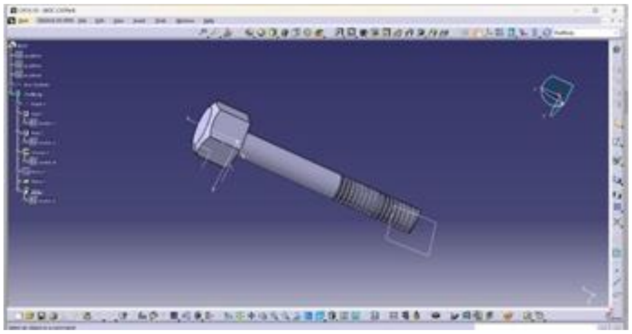

Figure 3.2: Bolt Part

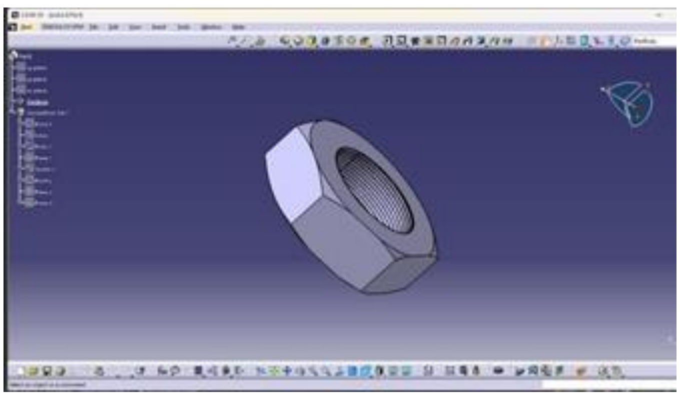

Figure 3.3: Nut Part

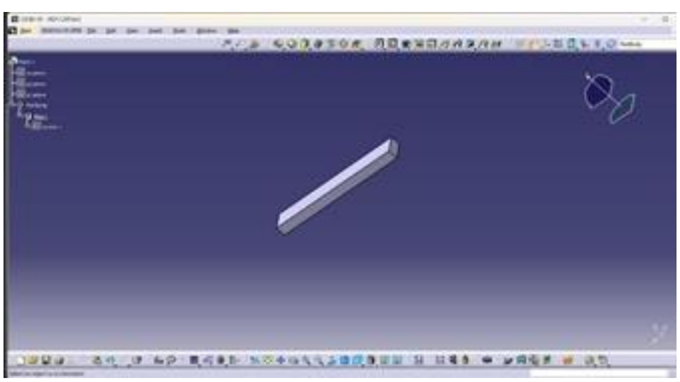

Figure 3.3: KEY PART

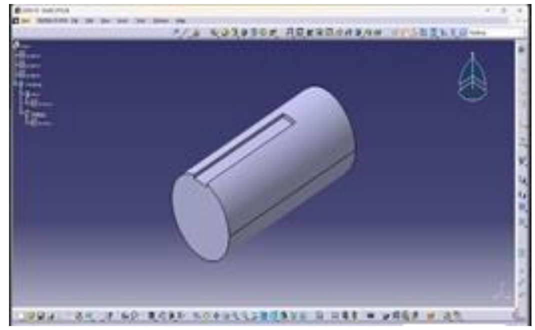

Figure 34: Shaft Part

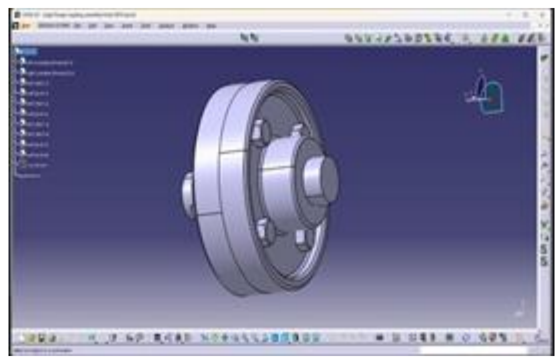

Figure 3.5: Rigid Flange Coupling Assembly

CHAPTER-4

4.1 INTRODUCTION TO FEA

Finite element analysis (FEA) is a fairly recent discipline crossing the boundaries of mathematics,physics, engineering and computer science. The method has wide application and enjoys extensive utilization in the structural, thermal and fluid analysis areas. The finite element method is comprised of three major phases: (1) **pre-processing**, in which the analyst develops a finite element mesh to divide the subject geometry into subdomains for mathematical analysis, and applies material properties and boundaryconditions, (2) **solution**, during which the program derives the governing matrix equations from the model and solves for the primary quantities, and (3) **post-processing**,

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

in which the analyst checks the validity of the solution, examines the values of primary quantities (such as displacements and stresses), and derives and examines additional quantities (such as specialized stresses and error indicators).

4.2Model

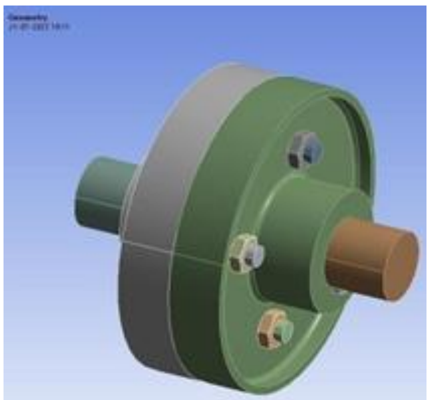

Figure 4.2.1: Importing Geometry into Ansys

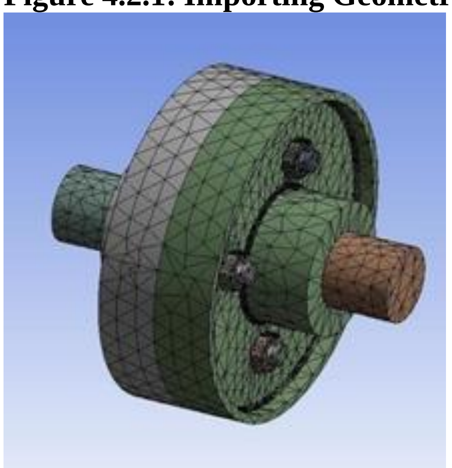

Figure 4.2.2: Meshing Body

4.2 SPECIFYING THE BOUNDARY CONDITIONS:

The selection are named as the further purpose i.e.., to give the boundary conditions ,etc., Hencethe boundary conditions are marked.

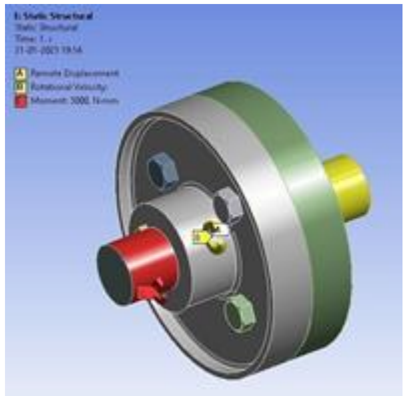

Figure 4.3.1: Boundary Conditions

4.3 SOLUTIONS:
SOLUTIONS WITH MATERIAL STRUCTURAL STEEL

VON-MISES STRESS OF RIGID FLANGECOUPLING:

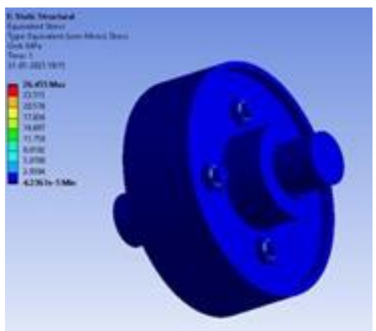

Figure 4.4.1: Von Mises Stress :26.45mpa

VON-MISES STRAIN OF RIGID FLANGECOUPLING :

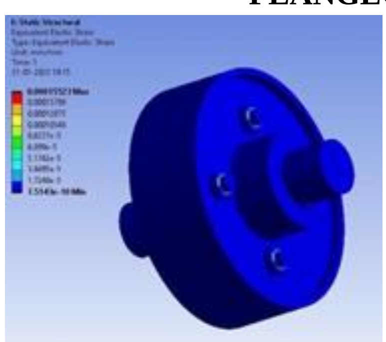

Figure 4.4.2: Vonmises Strain:1.5e-4

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

MODAL SHAPES OF TOTAL DEFORMATIONS WITH PLAINCARBON STEEL:

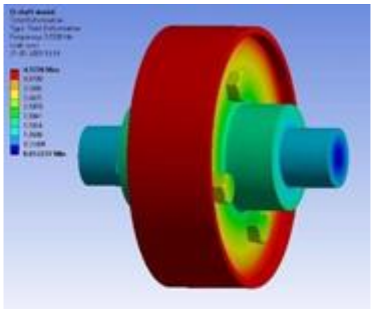

Figure 4.4.3: mode-1;Frequency: 355.83Hz

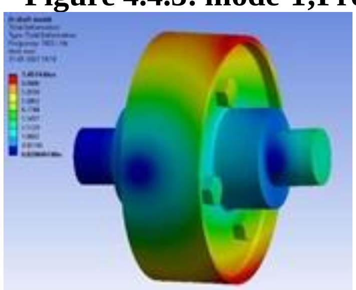

Figure 4.4.5: Mode-2; Frequency: 1633.1Hz

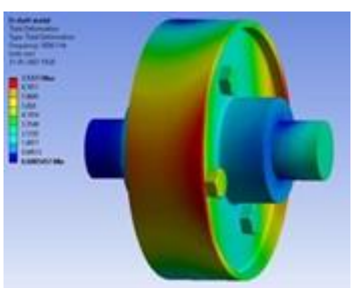

Figure 4.4.6: Mode-3; Frequency:1636.1 Hz

SOLUTIONS WITH MATERIAL ALLOY STEEL:

Materials:

- Flange – Gray cast iron
- Shaft – Plain carbon steel
- Keys, nuts and bolts- ALLOY steel
- Factor of safety =2.5

ALLOY STEEL:

- Youngs Modules: 210 GPA
- POSSIONS RATIO: 0.28
- Density: 7700 Kg/cm3

VON-MISES STRESS OF RIGID FLANGECOUPLING:

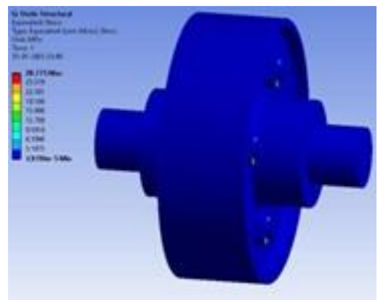

Figure 4.4.7: Von Mises Stress :28.77mpa

VON-MISES STRAIN OF RIGID FLANGECOUPLING:

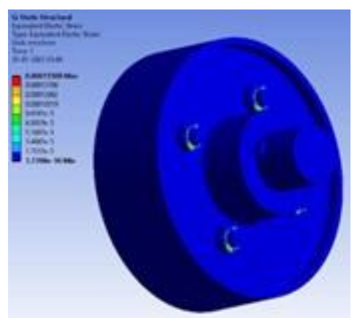

Figure 4.4.8: Vonmises Starin:1.5e-4

MODAL SHAPES OF TOTAL DEFORMATIONS WITH MATERIALALLOYSTEEL:

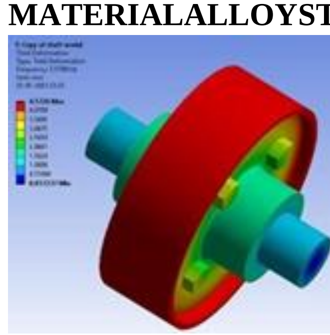

Figure 4.4.9: Mode-1; Frequency: 357.98Hz

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

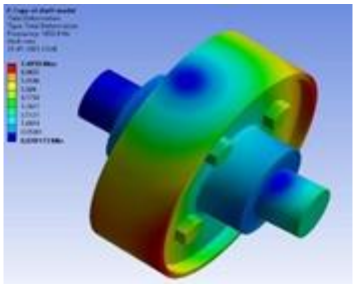

Figure 4.4.10: Mode-2; Frequency: 1633.9 Hz

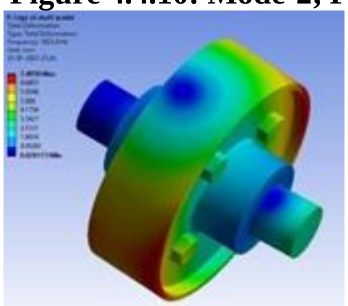

Figure 4.4.11: Mode-3; Frequency: 1633.9 Hz

STRESS IN NUT & BOLT ASSEMBLY:

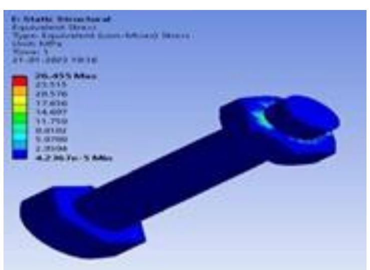

Figure 4.4.12: Stress In Nut & Bolt Von Mises Stress 26.455Mpa

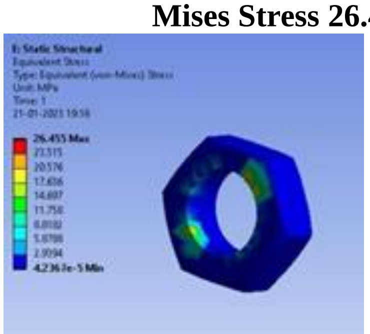

Figure 4.4.13: Von Mises Stress 26.455 Mpa

CHAPTER-5
RESULT TABLES & GRAPHS

5.1 RESULTS TABLE FOR PLAIN CARBONSTEEL:

MODE NO.	NATURAL FREQUENCY
1	3.5583
2	1633.1
3	1636.1
4	2075.1
5	2080.8
6	2323.5
7	2580.2
8	2599.7
9	4368.5
10	4368.8

Fig 5.1.1 TABLE1: NATURAL FREQUENCIES FORPLAIN CARBON STEEL

GRAPH:

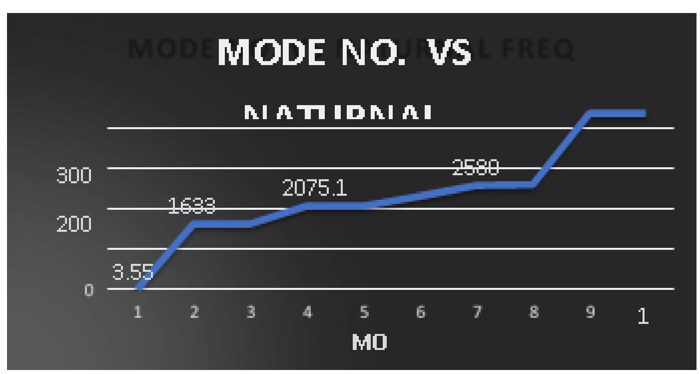

Fig 5.1.2 GRAPH1: MODE NO. VS

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

NATURNAL FREQUENCY

5.2 RESULTS TABLE FOR ALLOY STEEL:

MODE NO.	MODE FREQUENCY
1	3.5798
2	1633.9
3	1636.9
4	2075.7
5	2081.4
6	2325.7
7	2583.7
8	2602.4
9	4373.5
10	4373.6

Fig 5.2.1 TABLE2: NATURAL FREQUENCIES FOR ALLOYSTEEL

GRAPH

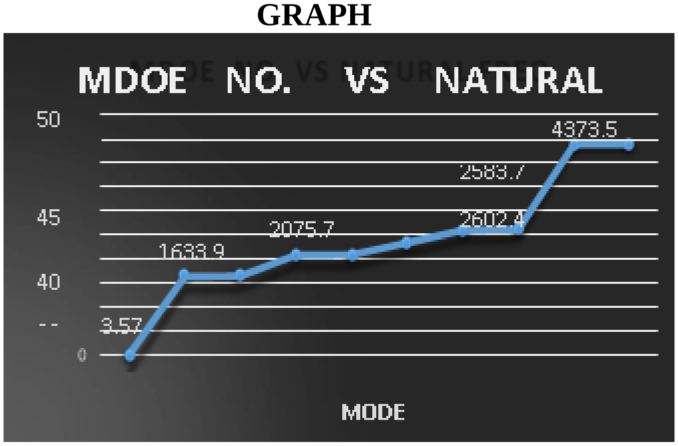

Fig 5.2.2 GRAPH 2: MODE NO. VS NATURNAL FREQUENCY

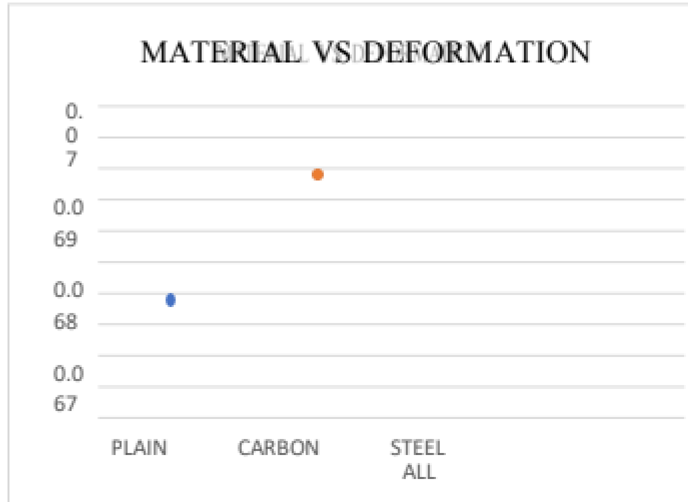

Fig 5.2.3 RAPH 3: MATERIAL VS DEFORMATION

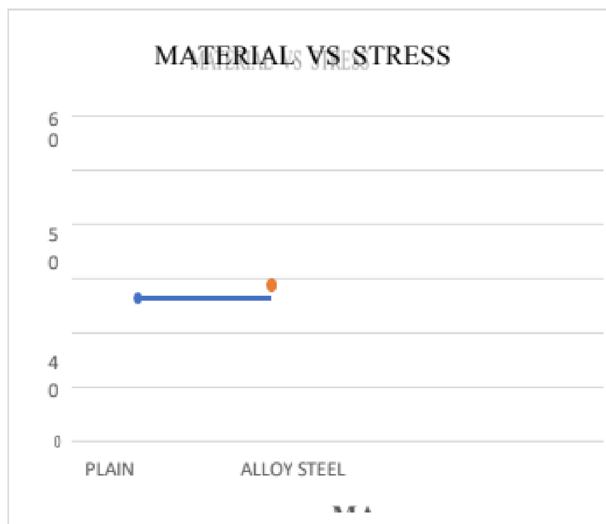

Fig 5.2.4 GRAPH 4: MATERIAL VS STRESS

CHAPTER-6 CONCLUSION:

In our project we have designed a rigid flange coupling. Loads are calculated when the coupling is the transmitting the power at 3000 N-m torque and different materials Grey Cast Iron, Plain Carbon steeland Alloy steel.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Structural and Frequency analyses are done on the rigid flange coupling to verify the best materialby taking in to account stresses, displacements, weight etc.

By observing the structural analysis results using Plain Carbon steel, the stress values are within the permissible stress value. So, using Plain Carbon steel is safe for rigid flange coupling. When comparing the stress values of the two materials, the value is less for Alloy Steel

And also, weight of the Plain Carbon steel is less when compared with the Alloy Steel since its densityis less. Thereby mechanical efficiency will be increased.

By observing analysis results, Plain Carbon steel is best material for Rigid flange coupling.

CHAPTER-7
REFERENCES:

- Praveena S Lavakumar M and Sreekanth Reddy S “Modeling and Structural Analysis ofDisc Brake” (IJIRSET), Vol. 3, Issue 10, October 2014, ISSN: 2319-8753
- Chandra Sekhar Katta, Kamana Srinivasa Rao, Design and Analysis of flange coupling ,International Journal of Professional Engineering Studies Volume VI /Issue 4 / AUG 2016
- Maram Venkata Sunil Reddy, C. Raghunatha Reddy, Design and Analysis of Universal Coupling Joint , International Journal of Engineering Science and Computing, December2016
- Prof. Salunkhe R.T., Mr. Patil N.T., Design, Modeling, Analysis of Propeller Shaft andCouplings, International Journal of Advanced Scientific and Technical Research Vol. 5.Sept-Oct 2013
- Shivaji G. Chavan “Stress Analysis of Flanged Joint Using Finite Element Method”(IJSR), Volume 3 Issue 8, August 2014, ISSN (Online): 2319-7064
- Shivaji G. Chavan “Stress analysis of flanged joint using finite element method”. (IJSR),Volume 3Issue 8, August 2014, ISSN (Online): 2319-7064
- V. G. Vijaya “Analysis of rigid flange coupling”. (IJIRSET), ISO 3297: 2007, Vol. 2,Issue 12,December 2013, ISSN: 2319-8753