DESIGN ANANALYSIS OF MULTIPLATE CLUTCH BY USING ANSYS

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ABSTRACT

A clutch is a mechanical device which provides for the transmission of power (and therefore usually motion) from one component (the driving member) to another (the driven member). The opposite component of the clutch is the brake. A multi plate clutch may be used when a large torque is to be transmitted. The inside discs are fastened to the driven shaft to permit axial motion. The outside discs are held by bolts and are fastened to the housing which is keyed to the driving shaft. The multi disc clutches are extensively used in motor cars, motorbikes, machine tools etc. The inside discs are usually made of steel and outside discs is usually made of bronze. The materials used for lining of friction surfaces are Cork, Rubber, Cast iron, Powder metal. The aim of the project is to design a multi plate clutch by using empirical formulas. A 2D drawing is drafted for multi plate clutch from the calculations and a 3D model is created in the 3D modeling software Pro/Engineer. I am conducting structural analysis for above design for validating design. I am conducting analysis by varying the friction surfaces material. By extracting the result we are going to find out which material is best for the lining of friction surfaces. Structural analysis is done for multi plate clutch using the properties of the two materials. Materials used for liner is Cork, Powder metal. Comparison is done for above all materials to validate better lining material for multi plate clutch under the different coefficient of friction conditions.

INTRODUCTION

Clutch is a mechanism for transmitting rotation, which can be engaged and disengaged. Clutches are useful in devices that have two rotating shafts. In these devices, one shaft is typically driven by a motor or pulley, and the other shaft drives another device. Let us take an instance where one shaft is driven by a motor and the other drives a drill chuck. The clutch connects the two shafts so that they can either be locked together and spin at the same speed (engaged), or be decoupled and spin at different speeds (disengaged). Depending on the orientation, speeds, material, torque produced and finally the use of the whole device, different kinds of clutches are used. The clutch in itself is a mechanism, which employs different configurations and different principles in various models available. In the following lines, we have provided the different kinds of clutches that are available.

Different Kinds of Clutches

Friction Clutch

Friction clutches are the most commonly used clutch mechanisms. They are used to transmit torque by using the surface friction between two faces of the clutch.

Dog Clutch

A dog clutch couples two rotating shafts or other rotating components not by friction, but by interference. Both the parts of the clutch are designed so that one pushes into the other, causing both to rotate at the same speed, so that they never slip.

Cone Clutch

Cone clutches are nothing, but frictional clutches with conical surfaces. The area of contact differs from normal frictional surfaces. The conical surface provides a taper, which means that while a given amount of actuating force brings the surfaces of the clutch into contact really slowly, the pressure on the mating surfaces increases rapidly.

Overrunning Clutch

Also known as the freewheel mechanisms, this type of clutch disengage the driveshaft from the driven shaft, when the driven shaft rotates faster than the driveshaft. An example of such a situation can be when a cyclist stops peddling and cruises. However, in case of automobiles going down the hill, you cannot take your feet off the gas pedal, as there is no free wheel system. If you do so, the whole engine system can be damaged.

Safety Clutch

Also known as the torque limiter, this device allows a rotating shaft to "slip" or disengage when higher than normal resistance is encountered on a machine. An example of a safety clutch is the one mounted on the driving shaft of a large grass mower. If a stone or something else is encountered by the grass mower, it stops immediately and does not hamper the blades.

Centrifugal clutch

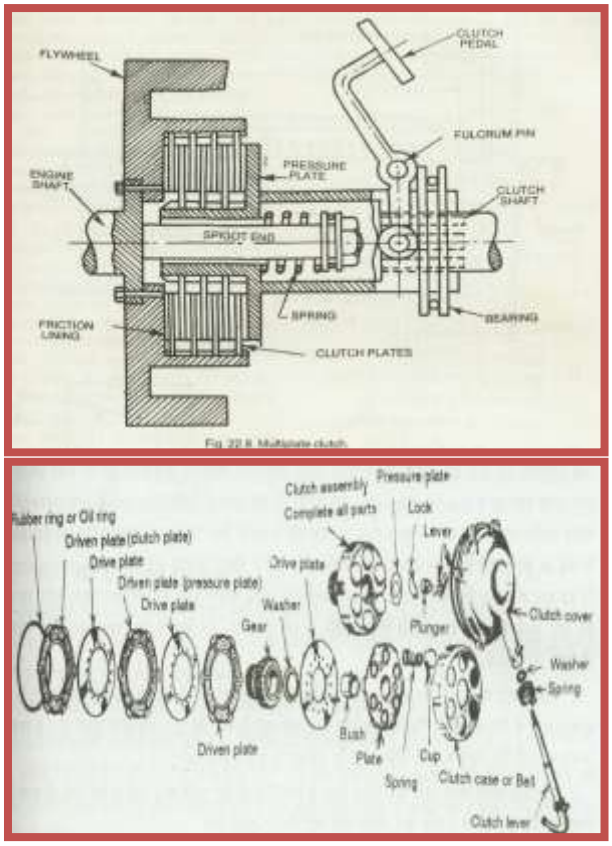
Centrifugal and semi-centrifugal clutches are employed where they need to engage only at some specific speeds. There is a rotating member on the driving shaft, which rises up as the speed of the shaft increases and engages the clutch, which then drives the driven shaft.

Hydraulic Clutch

In a hydraulic clutch system, the coupling is hydrodynamic and the shafts are not actually in contact. They work as an alternative to mechanical clutches. They are known to have common problems associated with hydraulic couplings, and are a bit unsteady in transmitting torque.

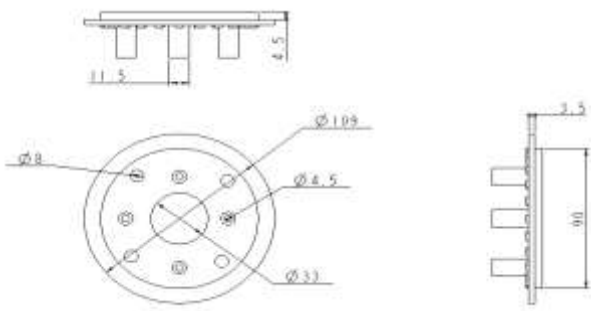
Electromagnetic Clutch

These clutches engage the theory of magnetism on to the clutch mechanisms. The ends of the driven and driving pieces are kept separate and they act as the pole pieces of a magnet. When a DC current is passed through the clutch system, the electromagnet activates and the clutch is engaged.

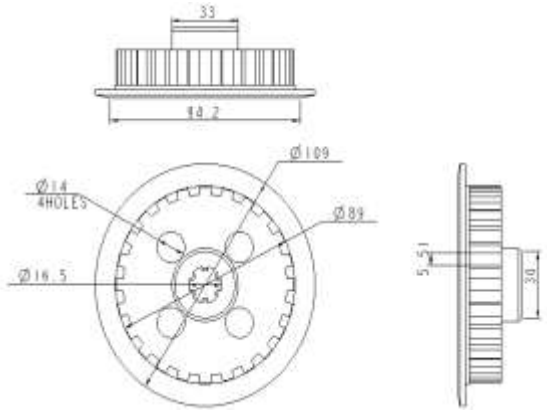


2D DRAWINGS

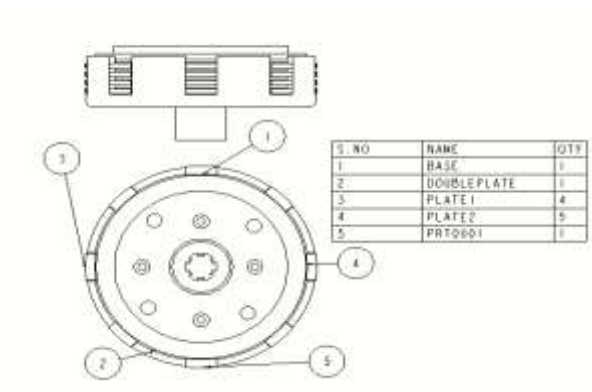
BASE PART



DOUBLE PLATE



ASSEMBLY



CREO is a suite of programs that are used in the design, analysis, and manufacturing of a virtually unlimited range of product.

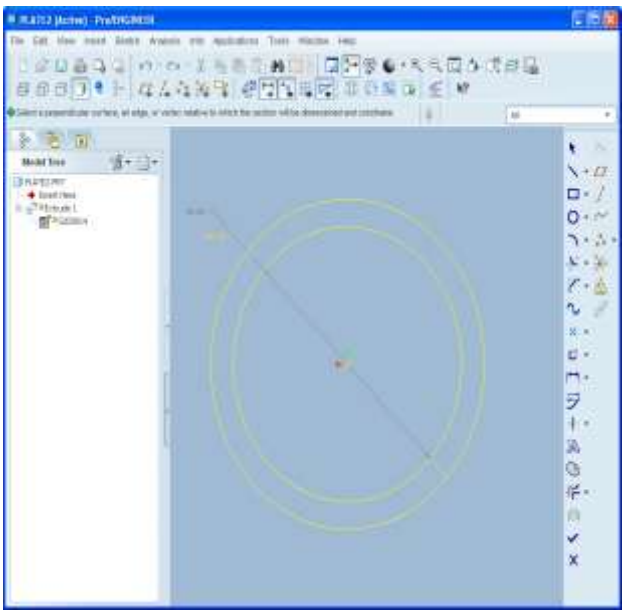
CREO is a parametric, feature-based solid modeling system, **"Feature based"** means that you can create part and assembly by defining feature like pad, rib, slots, holes, rounds, and so on, instead of specifying low-level geometry like lines, arcs, and circle& features are specifying by setting values and attributes of element such as reference planes or surfaces direction of creation, pattern parameters, shape, dimensions and others.

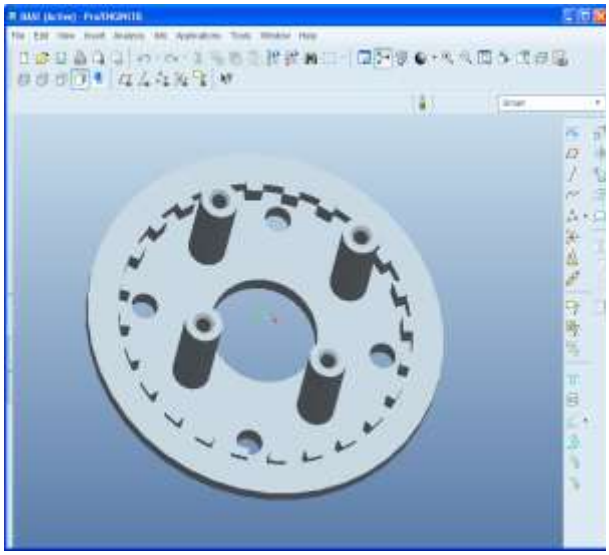
"Parametric" means that the physical shape of the part or assembly is driven by the values assigned to the attributes (primarily dimensions) of its features. Parametric may define or modify a feature's dimensions or other attributes at any time.

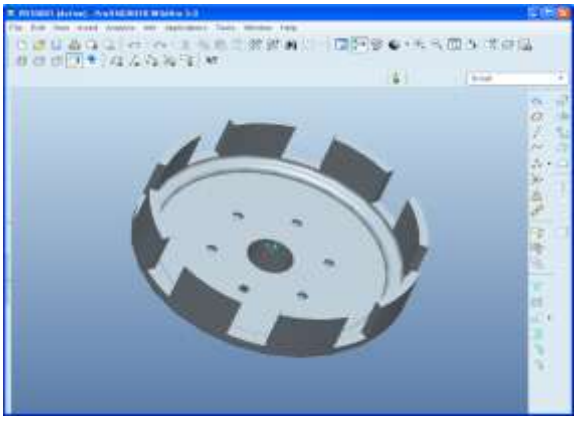
For example, if your design intent is such that a hole is centered on a block, you can relate the dimensional location of the hole to the block dimensions using a numerical formula; if the block dimensions change, the centered hole position will be recomputed automatically.

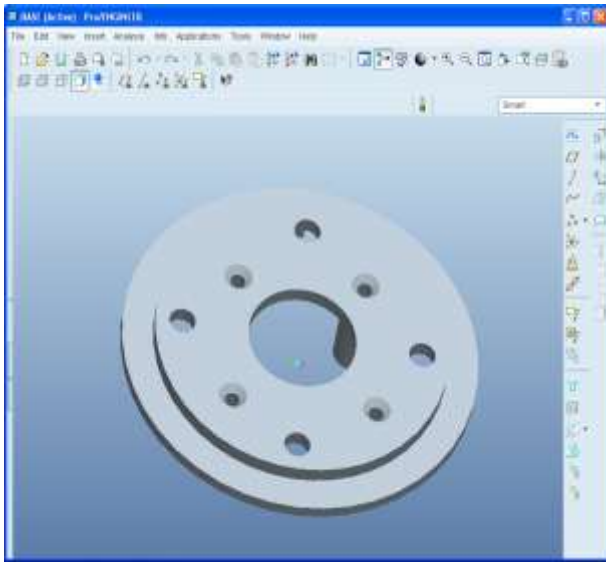
"**Solid Modeling"** means that the computer model to create it able to contain all the information that a real solid object would have. The most useful thing about the solid modeling is that it is impossible to create a computer model that is ambiguous or physically non-realizable.

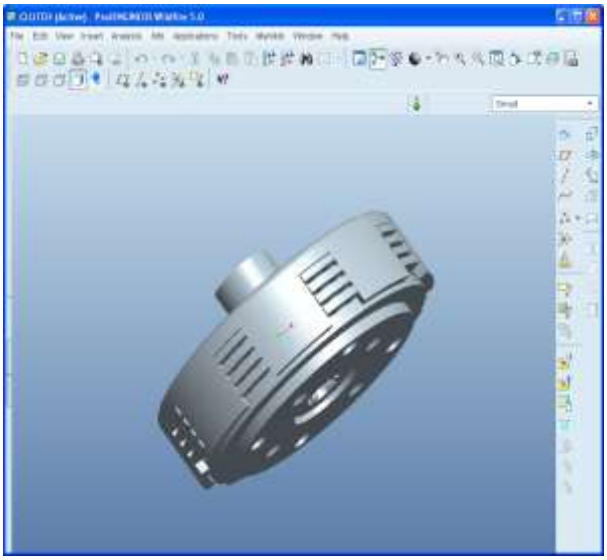
MODEL OF MULTIPLATE CLUTCH



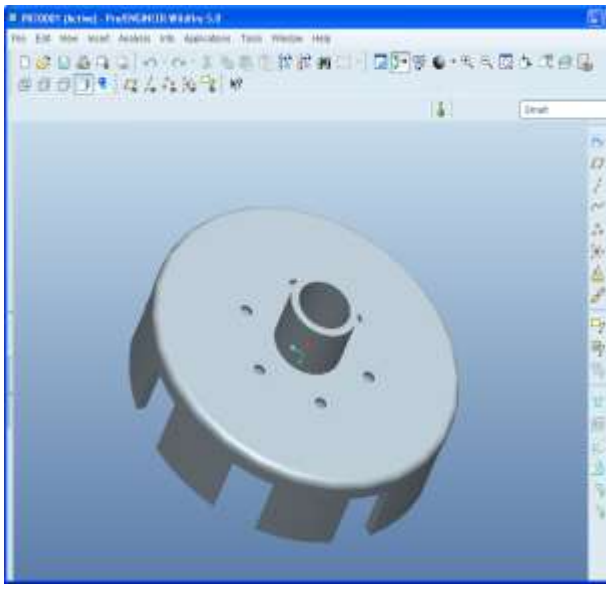


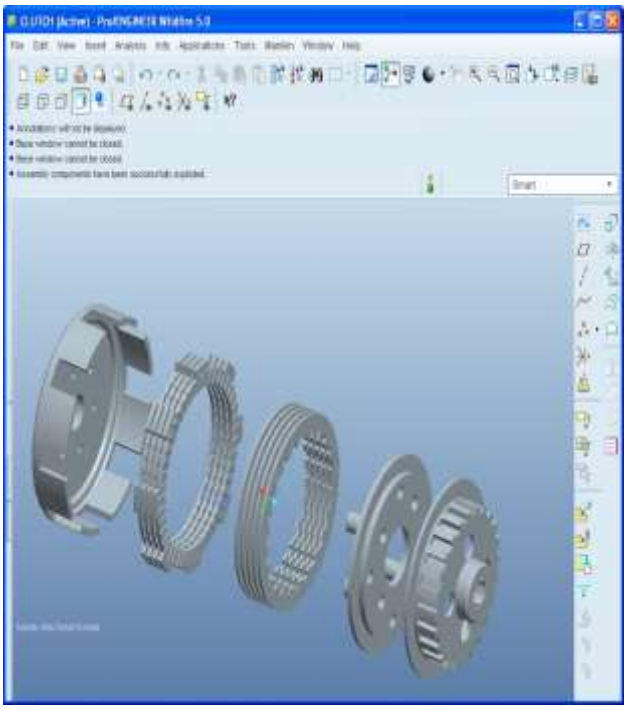






FRICTION PLATE 1





ANALYSIS

ANSYS is an Engineering Simulation Software (computer aided Engineering). Its tools cover Thermal, Static, Dynamic, and Fatigue finite element analysis along with other tools all designed to help with the development of the product.

The company was founded in 1970 by Dr. John A. Swanson as Swanson Analysis Systems, Inc. SASI. Its primary purpose was to develop and market finite element analysis software for structural physics that could simulate static (stationary), dynamic (moving) and heat transfer (thermal) problems. SASI developed its business in parallel with the growth in computer technology and engineering needs. The company grew by 10 percent to 20 percent each year, and in 1994 it was sold. The new owners took SASI's leading software, called ANSYS®, as their flagship product and designated ANSYS, Inc. as the new company name.

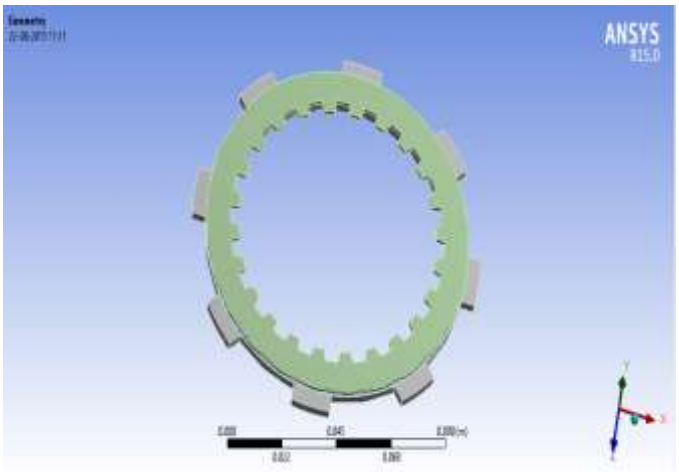
BENEFITS OF ANSYS:

- The ANSYS advantage and benefits of using a modular simulation system in the design process are well documented. According to studies performed by the Aberdeen Group, best-in-class companies perform more simulations earlier. As a leader in virtual prototyping, ANSYS is unmatched in terms of functionality and power necessary to optimize components and systems.
- *The ANSYS advantage is well-documented.*
- *ANSYS is a virtual prototyping and modular simulation system that is easy to use and extends to meet customer needs, making it a low-riskinvestment that canexpand as value is demonstrated within a company. It is scalable to all levels of the organization, degrees of analysis complexity, and stages of product development.*

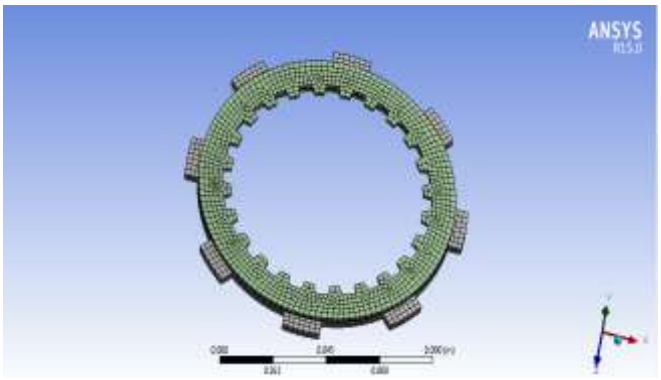
Finite Element Method

General Description of the Finite Element Method:

In the finite element method, the actual continuum or body of matter like solid, liquid or gas is represented as assemblage of sub divisions called finite elements. These elements are considered to be interconnected at specified joints, which are called nodes or nodal points. The nodes usually lie on the element boundaries where adjacent elements are considered to be connected. Since the actual variation of the field variable (like displacement, stress, temperature, pressure and velocity) inside the continuum is not known, we assume that the variation of field variable inside a finite element can be approximated by a simple function. These approximating functions (also called interpolation models) are defined in terms of the values at the nodes.



Import



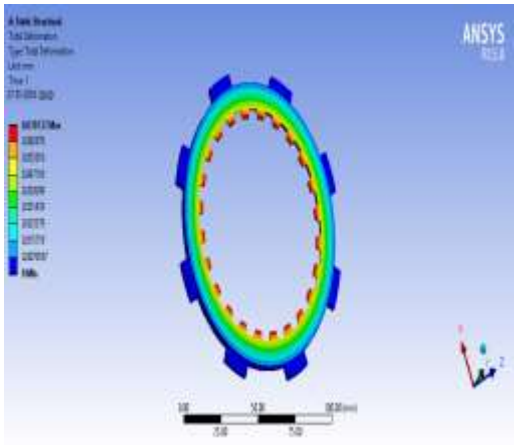
Meshing

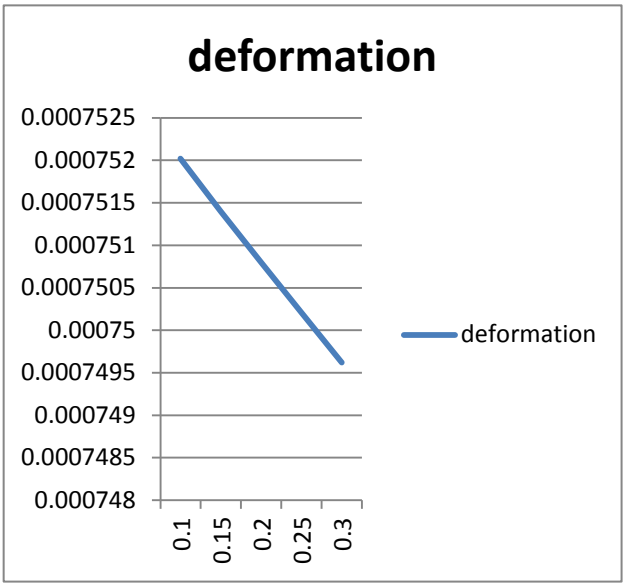
Results

For Friction

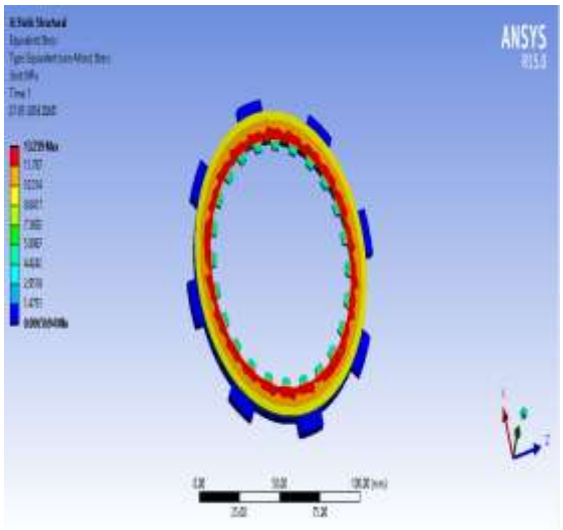
Cork as friction material

Deformation





Stress

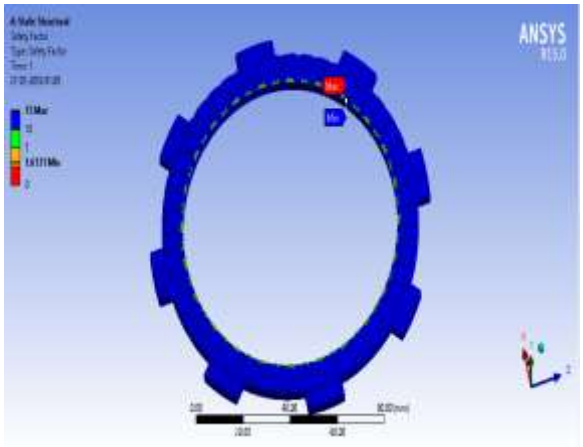


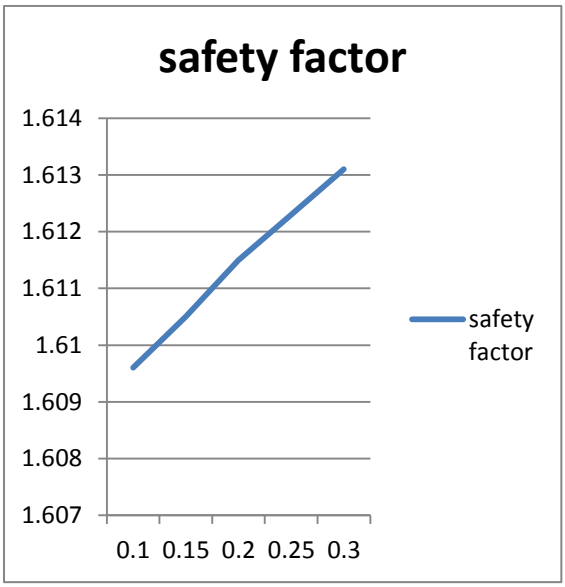
deformation

Co efficient of friction

From above results while increasing friction deformation decreasing safety factor

Fos

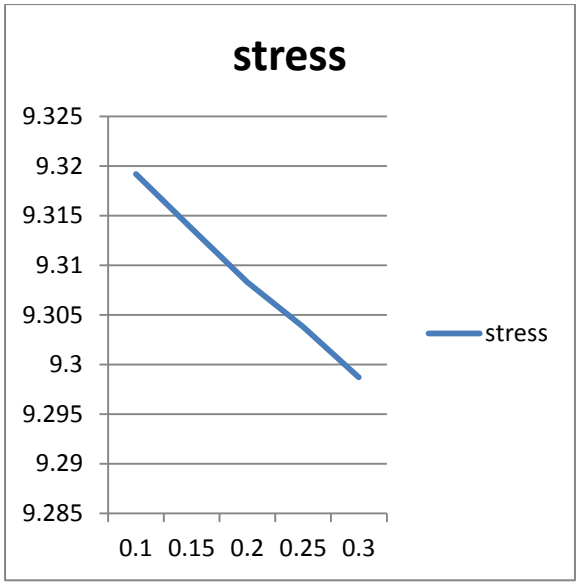




Co efficient of friction

While increasing friction values the safety factor also increasing Stress

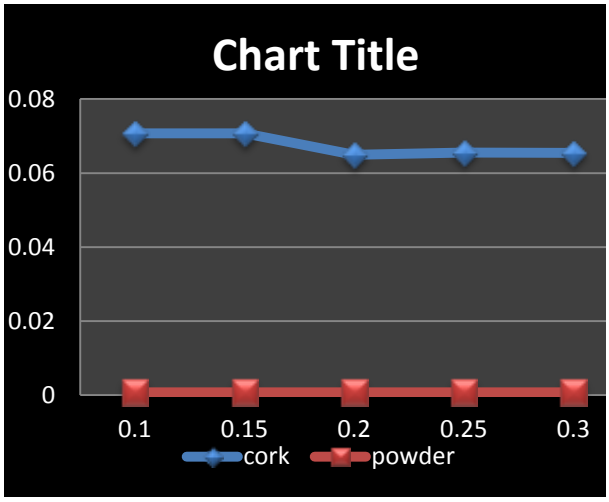
Graphs



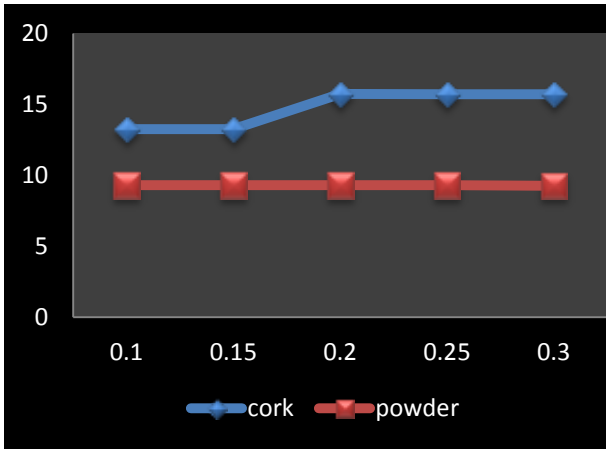
Co efficient of friction

From above results the stress is decreasing while friction increases

For all materials - Deformation



Stress



Fos

Co efficient of friction	cork	Cu powder metal
0.1	1.0904	1.6096
0.15	1.0907	1.6105
0.20	0.9555	1.6115
0.25	0.95518	1.6123
0.30	0.95519	1.6131

Calculations

From all the above clutch plates they have different weights, when we change material properties the weight will also change and the deformation values and stress and safety factor values also change, and we calculated all values and mention above, now we calculating stiffness of object

For 0.5mm thickness plate when we using cork as friction material it is 134 grams, To calculate stiffness we converting into Newton's

We Know That

1Kgf=9.81N

0.134/9.81= 1 Newton

1 N = 0.013700

Stiffness=weight/deformation

=0.013700/0.070737

= 0.19367 N/mm

For cu powder material

Weight =140 grams

And after converting into Newton's

N=0.014271

Stiffness=0.014271/0.00075202

=18.977 N/mm

CONCLUSION

In this paper the clutch plate has been designed by using CAD tool CREO-2 and then importing into (Ansys Work Bench) and the clutch plate made up of steel and bronze materials and cork as a friction material

For cork material we applied 0.25Mpa pressure on that and calculated results like deformation, stress and safety factor

From the above results it is identified that existing material while increasing coefficient of friction the stress value also increased and to avoid this and we chosen copper powder metal and analyzed with same boundary conditions. The changing materials having less stress values (9.2987) compare to existing material and have good safety factor values.

Finally the copper powder me have less deformation and stress values and high safety factor and stiffness compare to cork results.

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