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# Modelling and Assembly of Single Plate Clutch

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*ABSTACT*

***A Clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven by shaft may be started or stopped at will, without stopping the driving shaft. A clutch thus provides an interruptible connection between two rotating shafts. The present used material for friction disc is Cast Iron and aluminum alloys.***

***In this thesis analysis is performed using composite materials. The composite materials are considered due to their high strength to weight ratio. In this thesis composite material E Glass Epoxy and Aluminum Metal Matrix Composite are taken. A single plate clutch is designed and modeled using Catia v5 software.***

## 1 INTRODUCTION

A clutch is a mechanical device that provides for the transmission of power (and therefore usually motion) from one component (the driving member) to another (the driven member) when engaged, but can be disengaged.

Clutches are used whenever the transmission of power or motion must be controlled either in amount or over time (e.g., electric screwdrivers limit how much torque is transmitted through use of a clutch; clutches control whether automobiles transmit engine power to the wheels).

### 1.1 Friction clutches

Friction clutches are by far the most well-known type of clutches. The purpose of friction clutches is to connect a rotating member to one that is stationary, to bring it up to speed and to transmit power with little slippage.

### Materials

Various materials have been used for the disc friction facings, including asbestos in the past. Modern clutches typically use a compound organic resin with copper wire facing or a ceramic material. A typical coefficient of friction used on a friction disc surface is 0.35 for organic and 0.25 for ceramic. Ceramic materials are typically used in heavy applications such as trucks carrying large loads or racing, though the harder ceramic materials increase flywheel and pressure plate wear.

### 1.2 Single -plate clutches

The shell with the flange is fast connected with the driven machine part. Together with the external single-plates it creates the driven part of the coupling. The magnet body, in which gearing the internal single-plates engage, creates the driving part.

The internal single-plates are covered by the layer of the friction material according to the kind of the operation (lubricated or dry), that extends their service life and increases the friction. The external multi-plates drive by their steps the coupling shell.

### 1.2.2 The restoration of a single disk clutch

In order to proceed with the task of reinstalling a multiple disk clutch in an early 1928 Model A Ford that currently has a single disk clutch installed it is necessary to acquire all the required original hardware that was discarded. Since there are no new replacement parts available, it is necessary to acquire the needed original parts from the swap meet market.

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### 1.2.3Transmission and flywheel

To change back to a multiple disk clutch from a single disk clutch it is necessary to change the flywheel, the bell housing, and the transmission input shaft. The multiple disk clutch transmissions were slightly different. They did not use the A7050 front bearing retainer that the throw-out bearing mechanism slides on with a single disk clutch. In fact, there are no bolt holes in the front of the transmission case to mount one.

### 1.2.4 The throw out bearing

The multiple disk clutch used a completely different throw-out bearing than the one used with the single disk clutch. There are no new replacements; you have to locate an original. Surprisingly, most of the originals that I have seen were perfectly serviceable. These early throw-out bearings were better designed and better made. The grease fitting is mounted right on the bearing, and spins with the bearing. When you grease one of these throw-out bearings you are pumping grease directly into the bearing itself. When you grease a throw-out bearing on a single disk clutch, you are only applying grease to the slider part of the front bearing retainer, you are not greasing the bearing itself. That's probably why they eventually fail. As soon as the factory applied grease is gone, so is the bearing. The multiple disk throw-out bearing is mounted right on the clutch assembly and mounts backwards to the single disk throw-out bearing. The smooth machined surface of the bearing is pushed on by the fork located in the bell housing.

### 1.2.5The K. R. Wilson alignment tool

It is essential to have either the K. R. Wilson alignment tool shown on page 223 of the service bulletin, or a reasonable substitute. You can easily get the multiple disk clutch assembly apart using a shop press, and you can also put it back together using a shop press. However, unless you concoct a means of lining up the outer teeth of each of the four driving disks that has the composite lining material on them, you will never get the clutch installed in the flywheel. The alignment tool, or a shop press, is needed to compress yet another of Henry's "killer" springs. I was fortunate enough to acquire the loan of a K. R. Wilson alignment tool from a fellow Model A'er who is a 1928 purest and has a multiple disk clutch installed in his car.

### Driving and driven

The series of disks that make up a multiple disk clutch are divided into two categories, the driving disks, and the driven disks. There are four driving disks; each has outer teeth that mesh with the inside teeth machined into the flywheel. Both sides of the driving disks have a composite clutch material riveted on. The material is the same as used on a single disk clutch. The design provides eight sides of composite clutch surface. The driven disks are made of saw blade material and in fact look much like a circular saw blade. There are five driven disks.

### The driving disks

The composite material used on the driving disks is the same as that used on single disk clutches and any clutch rebuilding facility will have the capability of replacing the composite material on the driving disks. However, the cost is significant, as the clutch material has to be applied to both sides of four disks. On the other hand, many of the disks, in their original condition, are still serviceable. As long as the composite material is not torn or worn off, or hopelessly soaked in oil, they can be reused

### 1.2.6 The SINGLE disk clutch bell housing

The bell housing used with the single disk clutch is slightly different than the one used with the single disk clutch. There is another oil baffle (A7047-R) retained with a large snap ring (A7046-R) that attaches to the transmission side of the bell housing mounting surface. The bell housing must be bolted to the transmission housing before the multiple disk clutch assembly is mounted onto the transmission input shaft. To install the bell housing onto the back of the flywheel housing it is necessary to engage the external teeth of the four

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driving disks of the clutch with the internal teeth of the flywheel. This is where you hope the K. R. Wilson alignment tool was used correctly. The pedal shaft used with this early bell housing is smaller in diameter than those used with the single disk clutch. Early pedals with a matching diameter must be used with this bell housing.

### 1.2.7 The SINGLE DISK clutch flywheels
The flywheel used with the single disk clutch is completely different from the one used with the single disk clutch. The distinguishing feature is the internal teeth machined into the flywheel to accept the teeth of the driving disks. It is important that the flywheel teeth be clean and in good condition. Flywheels that have seen a lot of service will tend to have grooves worn into one side of the internal teeth caused by the mating teeth on the driving disks. There is no way to repair it, so select the best flywheel for use that you can find. The pilot bearing that is mounted in the center of the flywheel is held in place with a retainer plate (A7609-AR), and includes a felt insert (A7608-R).

### Friction materials
Wet friction material is one of the basic functioning components in wet clutch system. Before 20th century in fact only dry frictional pairs were used in clutches and brakes, and natural products like rubber, leather, cloth etc. were used for this purpose [19]. From 1918 asbestos fibers were introduced in this application. Later on around 1930's the longer lasting sintered materials came in the market to replace the asbestos one. With the improvement in the automobile industries after the 2nd world war, more and more research in this field provided with the newer and better friction materials from cork to carbon fibers and advanced resins for them [19, 20]. Some of these materials 9like asbestos fibers have also been restrained to use for the health and environmental risk since 1970 [21].

In generally there are three main types of friction materials used are:

(i) Paper based materials.
(ii) Carbon based materials.
(iii) Sintered bronze materials.
(iv) Other Friction Materials

There are also some new types of hybrid materials. These are typically manufactured using a similar process for manufacturing paper-based materials, where carbon fibers in combination with organic or synthetic fibers are used [26-28]. They can be used in more heavy duty applications where commonly sintered bronze, carbon fibers are sed. Hybrid materials are a cost effective alternative to carbon fiber materials [26].

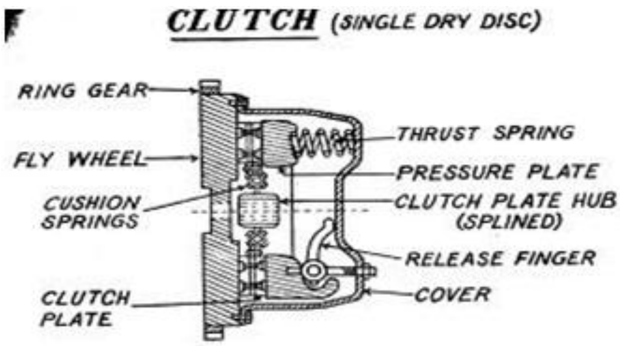


Figure 1.10 Clutch

## 2. LITERATURE REVIEW
Static And Dynamic Analysis of Clutch Plate with Crack by N.V.Narasimharao [2] has Done Research Work on Investigate How a Crack Propagates and Grows in a Clutch. A Clutch Plate Is Analyzed For Crack Propagation For Different Materials Aluminum Alloy 6061, Aluminum Alloy 7475, Composite Materials S2 Glass And Kevlar. Theoretical Calculations Are Done To Determine Stress Intensity Factor, Crack Extension Force, and Crack Opening Displacement. . From Dynamics And Fracture Mechanics, It Is Well Known That Accelerated Crack Nucleation And Micro-Crack Formation In Components Can Occur Due To Various Reasons, Such As Transient Load Swings, Higher Than Expected Intermittent Loads, Or Defective Component Materials. Normal Wear Causes Configuration Changes That Contribute To Dynamic Loading

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Conditions That Can Cause Micro Crack Formation At Material Grain Boundaries In Stress Concentrated Regions (Acute Changes In Material Geometry).

Structural Analysis Is Done On The Friction Plates To Verify The Strength. Friction Materials Used Are Lo31and Hybrid Sf-Bu.

Design And Analysis Of Clutch Plate Using Steel Material [En –Gjs-400 -15steel] by B. Nivas [6] to reduce the cost of clutch plate material without affecting the life and effectiveness of the clutch plate, we modify other material low carbon steel for clutch plate. The advantage of this project is to reduce the cost of clutch plate without affecting the function and life of clutch plate. They use steel en Gjs-400-15 as optional material to grey cast iron. These materials also have similar properties of grey cast iron. From analysis, they conclude d that maximum deformation in mm (pressure plate).

## 3. METHODS FOR DESIGN AND ANALYSIS TO DEVELOP THE WORK

### 3.1 Introduction to CAD/CAM/CAE

The Modern world of design, development, manufacturing so on, in which we have stepped can't be imagined without interference of computer. The usage of computer is such that, they have become an integral part of these fields. In the world market now the competition in not only cost factor but also quality, consistency, availability, packing, stocking, delivery etc. So are the requirements forcing industries to adopt modern technique rather than local forcing the industries to adapt better techniques like CAD / CAM / CAE, etc.

The Possible basic way to industries is to have high quality products at low osts is by using the computer Aided Engineering (CAE), Computer Aided Design (CAD) And Computer Aided Manufacturing (CAM) set up. Further many tools is been introduced to simplify & serve the requirement CATIA, PRO-E, UG are some among many.

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This penetration of technique concern has helped the manufacturers to

a) Increase productivity
b) Shortening the lead-time
c) Minimizing the prototyping expenses
d) Improving Quality
e) Designing better products

### SURFACE ON THE SKETCH

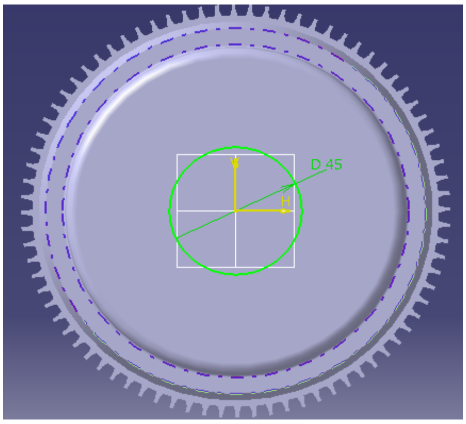


Figure 3.20

### PATTERN

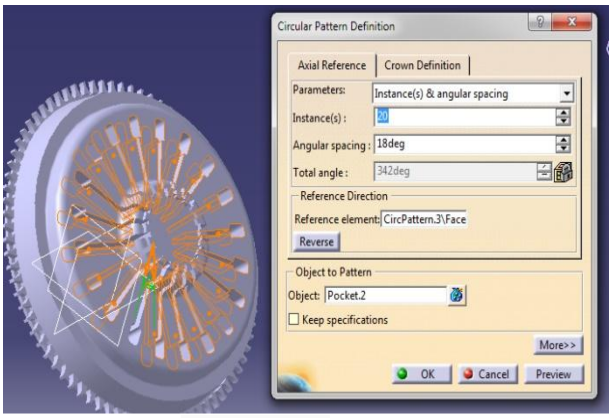


Figure 3.29 Pattern

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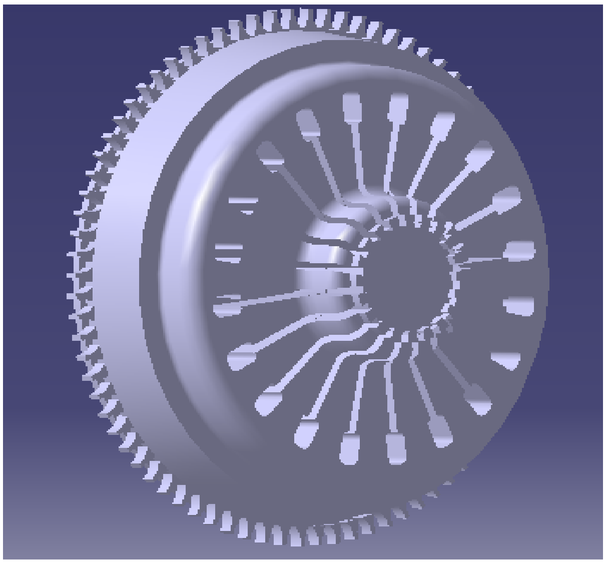
## THE MAIN SINGLE PLATE CLUTCH



## THE MAIN SINGLE CLUTCH PLATE

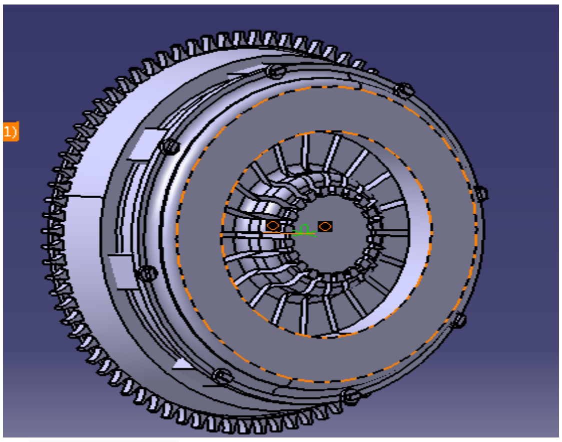


Figure 3.33 The main single clutch plate

## 4. ANALYSIS

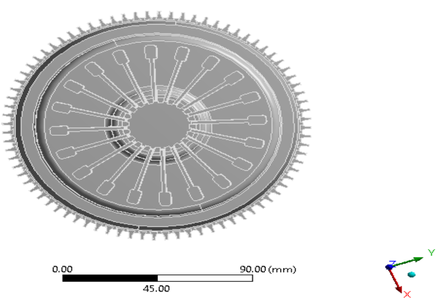



Figure 4.1: Single plate clutch model

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

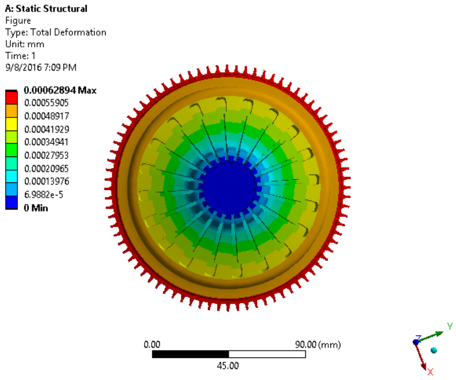



FIGURE 4.4

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

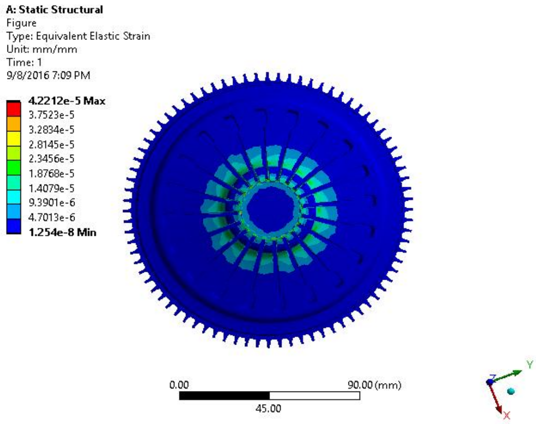



FIGURE 4.5

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

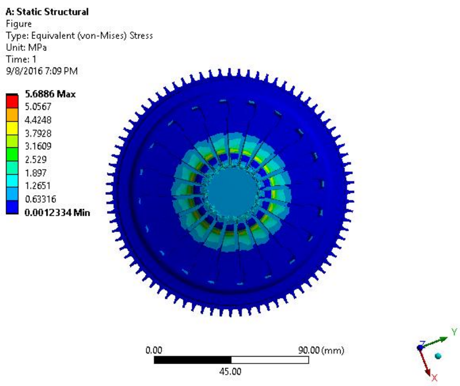



FIGURE 4.6

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

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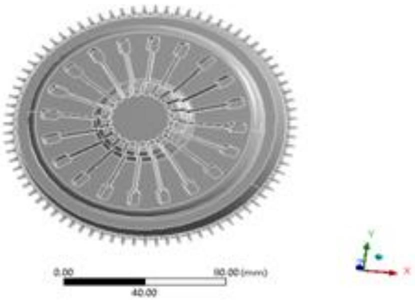


Figure 4.9

**Single plate clutch model**

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

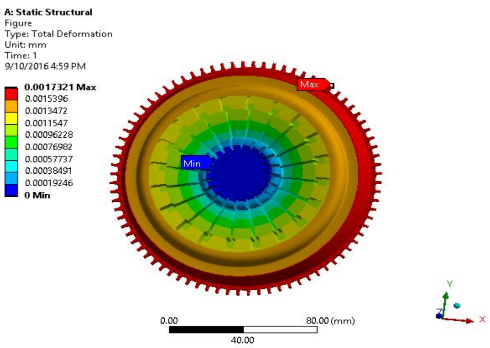


FIGURE 4.12

**TABLE 13**

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

| Time [s] | Minimum [mm/mm] | Maximum [mm/mm] |
|---|---|---|
| 1. | 3.4169e-008 | 1.1716e-004 |

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

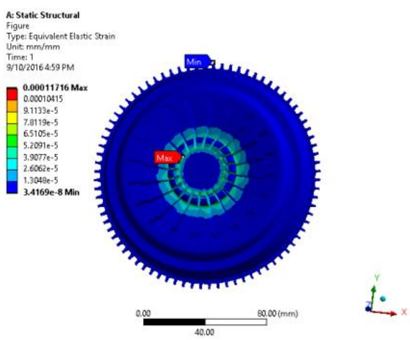


FIGURE 4.14

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

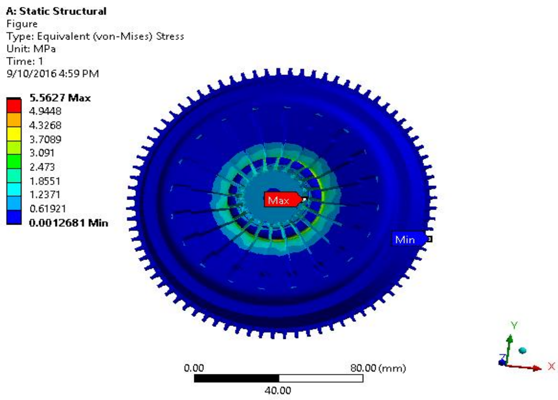


FIGURE 4.16

## 6. RESULTS

**Properties of Structural Steel**

| Name | Value |
|---|---|
| Compressive Ultimate Strength MPa | 0 |
| Compressive Yield Strength MPa | 250 |
| Tensile Yield Strength MPa | 250 |
| Tensile Ultimate Strength MPa | 460 |
| Young's Modulus MPa | 2 x $10^5$ |
| Poisson's Ratio | 0.3 |
| Bulk Modulus MPa | 1.6667 x $10^5$ |
| Shear Modulus MPa | 76923 |
| Relative Permeability | 1000 |

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### Properties of Aluminum Alloy

| Name | Value |
| --- | --- |
| Compressive Ultimate Strength MPa | 0 |
| Compressive Yield Strength MPa | 280 |
| Tensile Yield Strength MPa | 280 |
| Tensile Ultimate Strength MPa | 310 |
| Young's Modulus MPa | 71000 |
| Poisson's Ratio | 0.33 |
| Bulk Modulus MPa | 69608 |
| Shear Modulus MPa | 26692 |
| Relative Permeability | 1 |

### CONCLUSION& FUTURE SCOPE

1. In this thesis, a single plate clutch is modeled in 3D modelling software Catia V5.
2. Present used material for clutch is Cast Iron. In this thesis, it is replaced with Aluminium metal matrix composite and composite material E – Glass Epoxy.
3. The advantage of using aluminium alloys is their light weight. The advantage of using composite material is their strength to weight ratio.
4. By observing the static analysis results, the analyzed stress values are less than the respective yield stress values of Aluminium alloy, aluminium MMC and E – Glass epoxy. So using the materials is safe.
5. By comparing the results between materials, E – Glass Epoxy is more advantageous than other materials due to its less weight and high strength.
6. Theoretical calculations are also done to determine stresses for all the materials.
7. By observing the results, the stress values are less than the respective allowable stress values for all materials. By observing the E Glass Epoxy results, the stress value is less.
8. So it can be concluded that by analytical and theoretical results, E Glass Epoxy is better.

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