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ANALYTICAL AND FE ANALYSIS FOR A CLUTCH PLATE (KEVLAR 49) FOR A TWO WHEELER

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ABSTRACT

Clutches are meant for to transfer maximum torque with minimum heat generation. In order to stop the vehicle without stopping the engine not only that it also used to initiate the motion or increase the velocity of the vehicle by transferring kinetic energy from the flywheel. In this paper present firstly designing clutch plate with graphite and compare with the kelvar 49 materials. Modeled by using CATIA V5 software. And analytical approach for determine the stresses with uniform wear theory.

KEYWORDS: Clutch plate, gray cast iron, kevlar49

INTRODUCTION

Clutches are designed to transfer maximum torque with minimum heat generation. In order to stop the vehicle without stopping the engine, the wheels should be disconnected from the engine, which facilitates through clutch. It is a mechanism for transmitting rotation which can be engaged and disengaged.

The friction materials which are suitable for friction clutch plate are Gray cast iron, Cork, SF-BU, Kevlar49, SF001, Sintered iron Aluminum 6061, Steel, pressed asbestos, Bronze etc.

Mainly there are two types of clutches, one is single plate clutch which is used for small duty vehicles and the other is multi plate clutch, which has number of friction plates and steel plate's assembly used for heavy duty vehicles.

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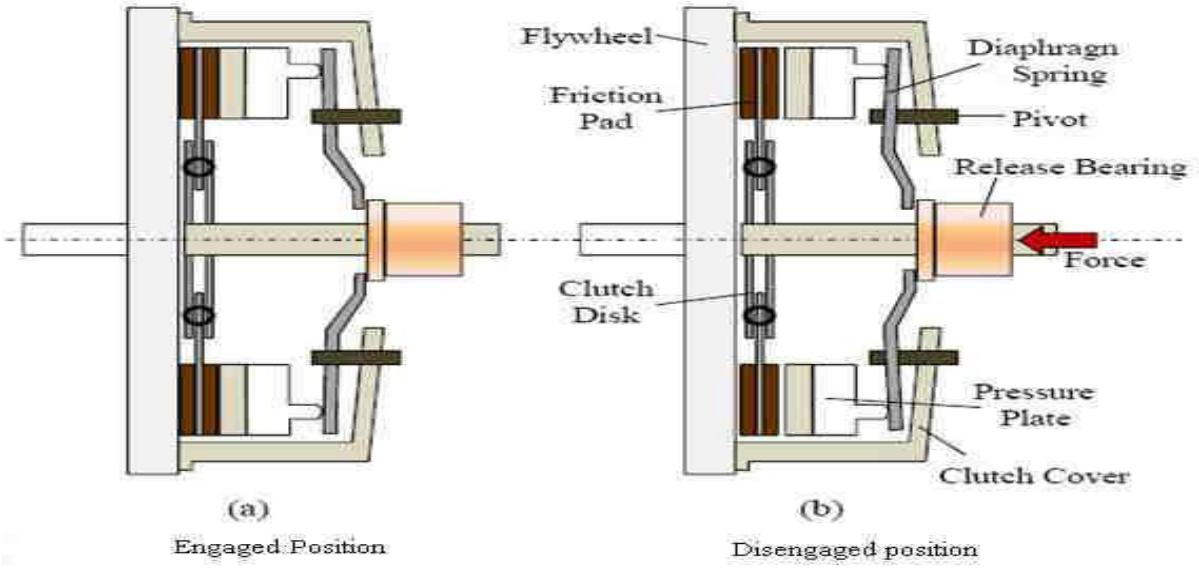

Fig 1(a) shows the engagement position of clutch plates, during this the clutch pedal is engaged with flywheel which transmit power from the engine to the clutch and it is transmitted towards the transmission. Fig (b) shows the disengagement of clutch plates, which does not transmit power towards the transmission.

LITERATURE REVIEW

The past literature revealed that Ganesh Raut et.al [1] has focused on comparision of diferent materials for friction surfaces by keeping the alumnium as base material and analysis of multi plate clutch. Jaykishore and Lava kumar [2] are proposed different materials for a multi plates and structural analysis of a multi plate clutch plates. A. Balaraju and chalam [3] [4] are presented frequency response of automobile under pulse and impulse distrabances. Joseph and M.Vasundara [5] and G.Pawar et.al [6] were demonstrated the total deformation of clutch plate for different materials to find the better lining material and structural analysis of multi plate clutch using ANSYS. Shaik Mohammad Ali and N.Amaranageswara [7] has studied about different materials for friction clutch plate and find the stress values for structural analysis and temperature values for thermal analysis of positive multiple Friction plate using FEA.

In this paper, the designed clutch plate by using CATIA V5 R20 software and structural analysis of graphite and Kevlar49 materials and compare the both in view of stresses.

NOME NCLATURE AND SELECTION OF MATERIALS

T Torque, Nm
n Speed, rpm
r_1,r_2 inner and outer radius of friction face, mm
R mean radius of friction surface, mm **n_1,n_2** no. of discs on driving and driven shafts
W Total operating force, N
P Intensity of pressure N/mm ^{2}
μ Coefficient of friction

Gray cast iron as Friction material

Gray iron, or grey cast iron, is a type of cast iron that has a graphitic microstructure. It is named after the gray color of the fracture it forms, which is due to the presence of graphite. It is the most common cast iron and the most

Widely used cast material based on weight. The clutch disc is generally made from grey cast iron (Afferents et al. 2003; Poser et al. 2005). This is because grey cast iron has a good wear resistance with high thermal

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conductivity and the production cost is low compare to other clutch disc materials such as A1-MMC (aluminum-metal matrix composite), carbon composites and ceramic based composites (Terhech et al. 1995; Jaet al. 2003). High thermal conductivity of diffusivity of the material is considered advantageous because heat is allowed to dissipate at higher rate.

Table 1: Material properties for Gray cast iron and Kevlar 49

S.No.	Material	Density (Kg/m^3)	Poisson's ratio	Tensile strength (Mpa)	Coefficient of Friction
1	Gray Cast iron	7200	0.29	220	0.28
2	Kelvar 49	1439.35	0.36	124	0.5

Kevlar 49 as friction material

Kevlar was introduced by DuPont in the 1970s. It was thefirst organic fiber with sufficient tensile strength andmodulus to be used in advanced composites. Originally developed as areplacement for steel in radial tires, Kevlar is now used in a wide range of applications.Kevlar 49 high strength material was used commercially for the first time in the early 70s as are placement for steel in racing tires. Kevlar has found many applications, ranging from bicycle tires to body armor. By this measure it is about 5 times stronger than steel on an equivalent weight basis. It is suitable for mooring lines when used as a woven material, for underwater applications and for possible replacement as lining material.

MATHEMATICAL CALCULATION AND METHODOLOGY

Consider a practical vehicle such as passion

Gray cast iron friction material

Required operating force: $T = n*\mu*w*R$

$7.95=8\times0.28\times w\times0.04$

$W=7.95\div(8\times0.28\times0.05)$

$W=78.869N$

Average operating pressure:

$w=(2\times\pi\times P\times r2)\times(r1-r2)$

$44.167=(2\times\pi\times p\times36.13)\times(54.2-36.13)$

$P= 0.019$ MPa.

Kevlar 49 friction material

Required operating force:

$T = n*\mu*w*R$

$7.95=8\times0.36\times w\times0.04$

$w=7.95\div(8\times0.36\times0.04)w = 61.343$ N

Average operating pressure:

$w=(2\times\pi\times P\times r2)\times(r1-r2)$

$61.43 = (2\times\pi\times P\times36.13)\times(54.2-36.13)$

$P = 0.015$Mpa

FINITE ELEMENT ANALYSIS OF CLUTCH PLATE

The multi plate clutch has modeled in CATIA V5 R20 software and imported in ANSYS Workbench 14.5. The structural analysis has been carried out for both Gray cast iron and Kevlar 49 friction material clutch plate. The results of using both friction materials have been compared based on the total deformation of the friction plate.

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Friction material as gray cast iron

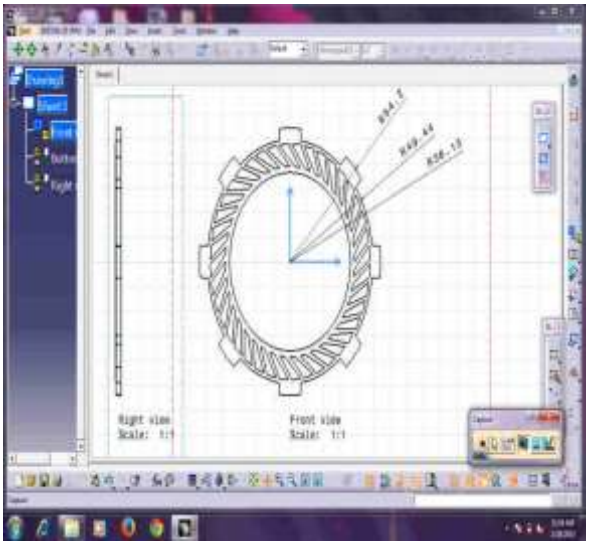

Fig 2: 2-D model of friction plate

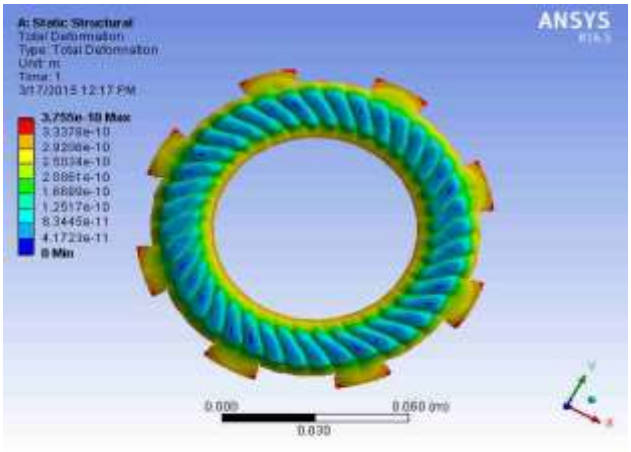

Fig 3: Total deformation

The total deformation for gray cast iron friction plate occurs at the edges and it is about3.755e-^{10}m, which is as shown in the figure 3.

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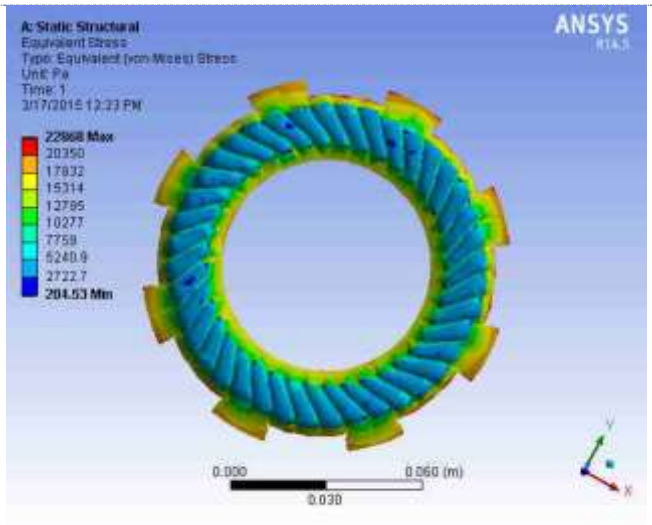

Fig 4: Equivalent (vonmises) stress

The figure 4. shows the vonmises stress for gray cast iron friction clutch plate, the maximum stress will occur across the edges of the friction plate.

Friction material as kelvar49

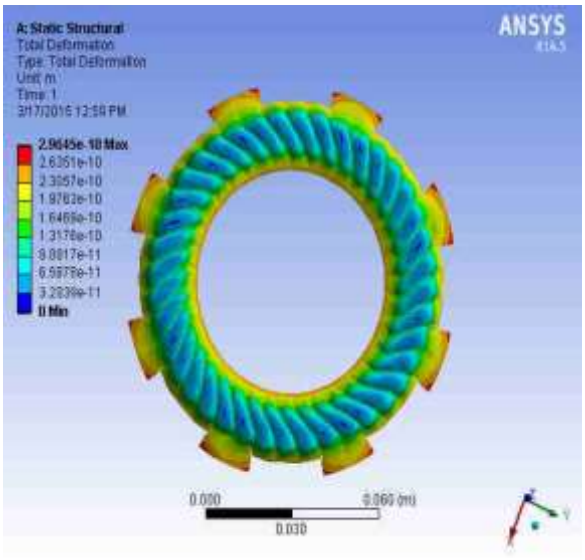

Fig 5: Total deformation

The total deformation for Kevlar49 friction plate occurs at the edges and it is about $2.9645e^{-10}$ m, which is as shown in the above figure 5.

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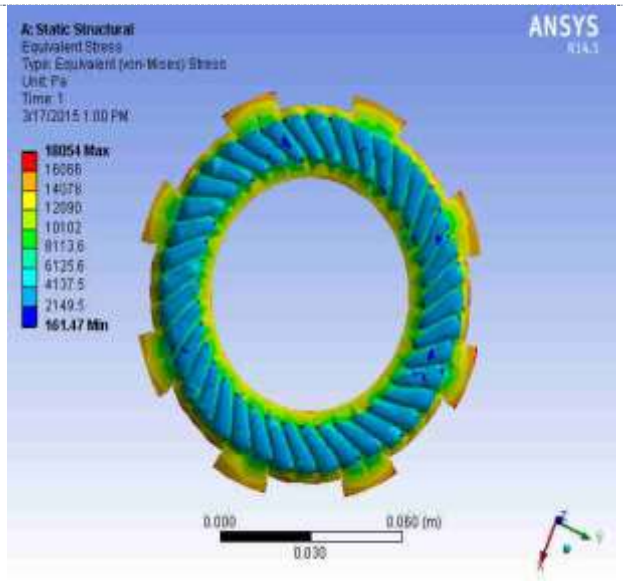

Fig 6: Equivalent (von mises) stress

he above figure shows the von mises stress for Kevlar49 friction clutch plate, the maximum stress will occur across the edges of the friction plate.

Table 2: Structural analysis results

Material	Vonmisses Stress (Pas.)	Total Deformation (m)
Gray cast iron	22868	$3.755\ e^{-10}$
Kelvar 49	8054	$2.9645\ e^{-10}$

CONCLUSION

In this paper, a friction plate has been designed by using CATIA V5 R20 software and theoretical calculations and also structural analysis has done by using ANSYS Workbench 14.5.

The materials gray cast iron and Kevlar 49 has been selected for friction plate and structural analysis has been done to find the total deformation, equivalent (von mises) stress and equivalent elastic strain. By comparing the results it is clear that Kevlar 49 has less deformation than Gray cast iron. Thus the material Kevlar 49 is more advantageous than Gray cast

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