RESEARCH ARTICLE OPEN ACCESS

Static & Thermal Analysis of Positive Multiple Friction Plate using FEA Package

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Abstract—
Clutch is a mechanical device, which is used to engage or disengage the source of power from the rest of the power transmission system at the operator's will. The clutch can connect or disconnect the driving shaft from the driven shaft when necessary. Clutches are designed to transfer maximum torque with minimum heat generation. During engagement and disengagement the two clutch discs has the sliding motion between them.
The project contains that designing and analysis of two positive multi friction plates.
For the designing of the friction plates 3d modeling software used and for the analysis ansys package is used.
In the analysis part the two models are analyzed with different materials by conducting two types of analysis which are structural and thermal.
Structural analysis is done to find out the stress values and the thermal analysis done to find out the temperature distribution on the model. By these two analysis results we are suggesting the best material to the effective model of the multiple friction plate.
Keywords— friction plates , *Kevlar 49, LO31,* ***Positive clutch plate ,*** *RP01….*

I. INTRODUCTION

Multi plate clutch comes under the category of friction clutch. Multi plate clutch is an extension of single plate type where the number of friction and metal plates is increased. The increases in the number of friction surfaces obviously increase capacity of clutch to transmit torque, the size remaining fixed.
Alternatively, the overall diameter of clutch is reduced for the same torque transmission as a single plate clutch. This type of clutch is, therefore used in some heavy transport vehicles and racing cars where high torque is to be transmitted. Besides, this finds application in case of scooters and motorcycles,
where space available is limited

Desirable properties for friction materials for clutches:

- The two materials in contact must have a high coefficient of friction.
- The materials in contact must resist wear effects, such as scoring, galling, and ablation.
- The friction value should be constant over a range of temperatures and pressures The materials should be
- resistant to the environment (moisture, dust, pressure)
- The materials should possess good thermal properties, high heat capacity, good thermal conductivity, withstand high temperatures Able to withstand high contact pressures
- Good shear strength to transferred friction forces to structure.

Fig.1 Positive clutch plate

- **Clutch plates**

A clutch plate is part of series of discs inside of a transmission. The clutch plate is round and has a friction sensitive surface that allows it to grip. It sits next to the fly wheel, which is connected to the drive shaft permanently. That means the flywheel immediately starts to spin as soon as the engine is turned on and the motor turns the crankshaft. When this happens in a manual transmission, the clutch must be disengaged. That is, it is pulled back from the flywheel, so it can spin without engaging the wheels.

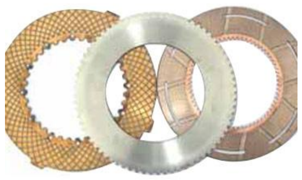

Fig.2 Positive Clutch plates

Types of clutch plates

- Wet Clutch

Wet clutch are universal and found on any bike. Almost 99% of motorcycle manufactured uses this kind of clutch. In the wet clutch set up the entire clutch is inside the case of the bike. Here it is bathed in oil which acts like a kind of dampener. It stops the clutch from knocking on itself.

- Dry Clutch

The dry clutch is almost identical to the wet clutch the only difference s there are seals on the shafts that keep oil out. In the dry clutch set up the entire clutch is outside the case of the bike. There is no oil circulated in to the clutch, which result into clutch knocking on itself. Ducati's are almost the only bike with this type of clutch.

II. MODELING IN PRO-E

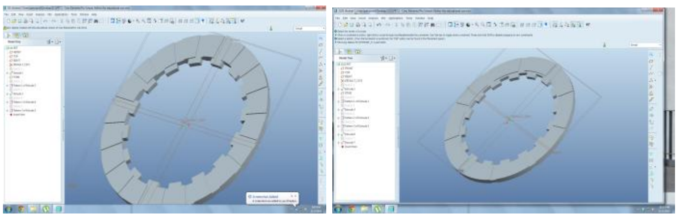

Fig.3&4 actual & modified models

III. ANALYSIS BY USING ANSYS

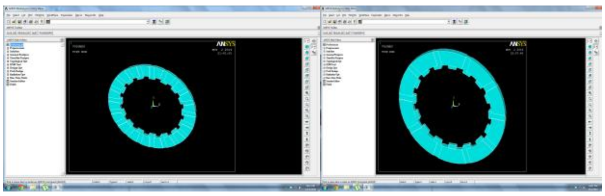

Fig.5&6 imported actual & modified models

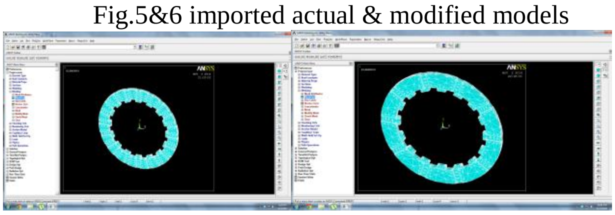

Fig.7&8 meshed actual & modified models

IV. RESULTS & DISCUSSION

Actual model structural analysis results:

- **For friction material Kevlar 49**

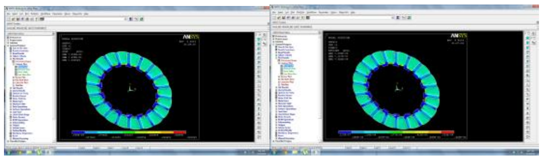

Fig.9&10 Stress intensity & Strain intensity

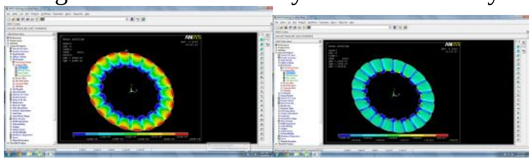

Fig.11 & 12 Deformed shape & Vonmisses stress

- **Friction material LO31**

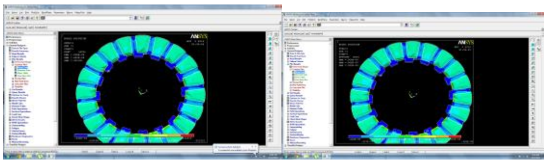

Fig.13&14 Stress intensity & Strain intensity

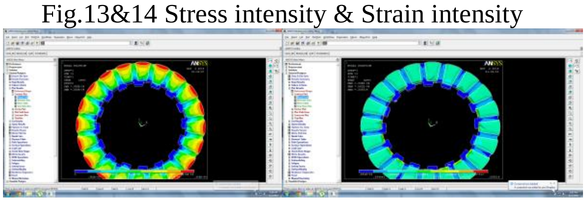

Fig.15 & 16 Deformed shape & Vonmisses stress

- **Friction material RP01**

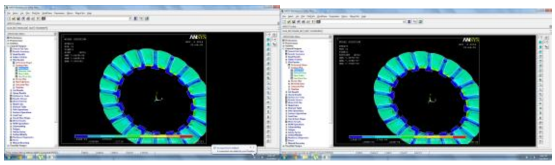

Fig.17&18 Stress intensity & Strain intensity

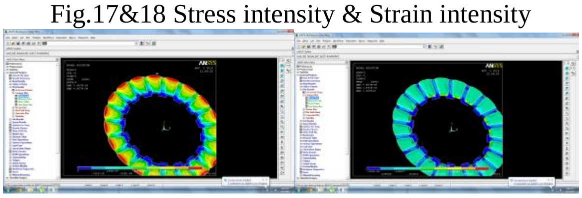

Fig.19 &20 Deformed shape & Vonmisses stress

Actual model thermal analysis results:

- **For friction material Kevlar 49**

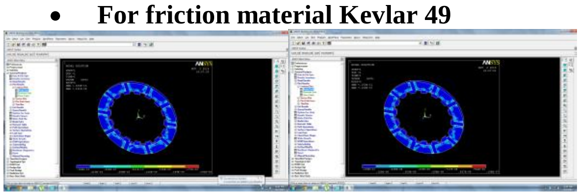

Fig.21 &22 Thermal gradient & Thermal flux

- **Friction material LO31**

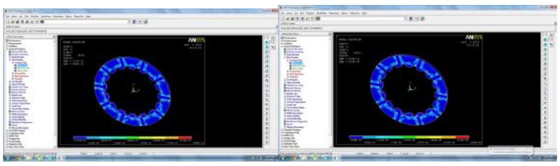

Fig.23 &24 Thermal gradient & Thermal flux

- **Friction material RP01**

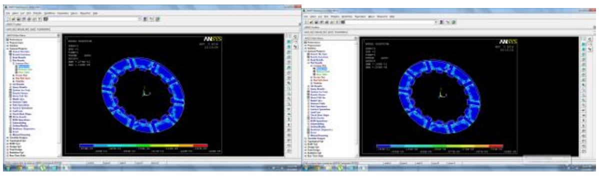

Fig.25 &26 Thermal gradient & Thermal flux

Modified model structural analysis results:

- **For friction material Kevlar 49**

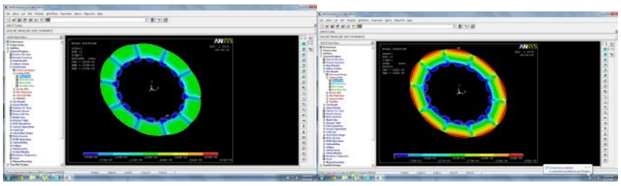

Fig.27 &28 Strain intensity & Deformed shape

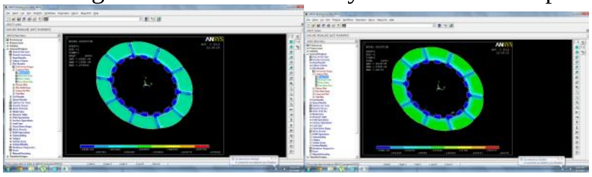

Fig.23 &30 Vonmisses stress & Stress intensity

- **Friction material LO31**

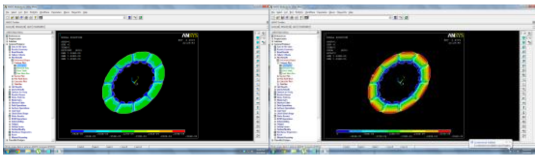

Fig.31 &32 Strain intensity & Deformed shape

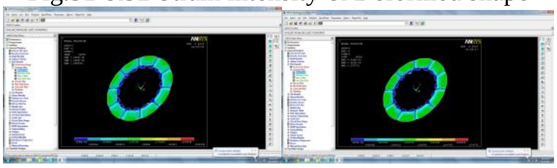

Fig.33 &34 Vonmisses stress & Stress intensity

- **Friction material RP01**

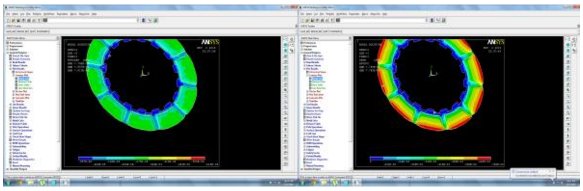

Fig.35 &36 Strain intensity & Deformed shape

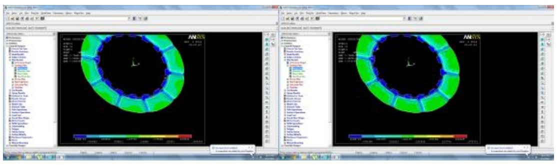

Fig.37 &38 Vonmisses stress & Stress intensity

Modified model thermal analysis results:

- **For friction material Kevlar 49**

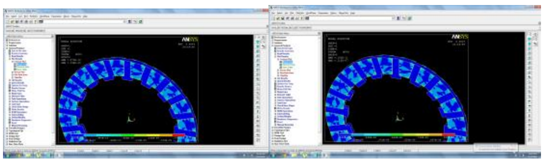

Fig.39 &40 Thermal gradient & Thermal flux

- Friction material LO31

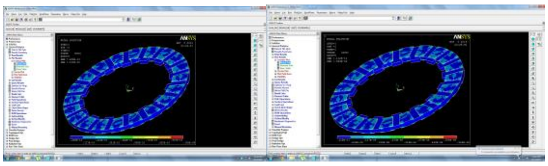

Fig.41 &42 Thermal gradient & Thermal flux

- **Friction material RP01**

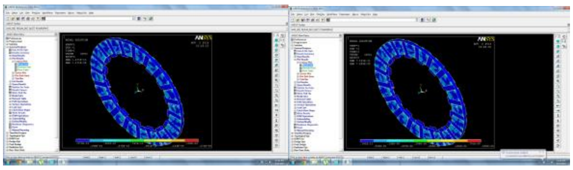

Fig.43 & 44 Thermal gradient & Thermal flux

V. RESULTS SUMMARY

	ACTUAL MODEL		MODIFIED MODEL	
	STRESS INTENSITY	THERMAL FLUX	STRESS INTENSITY	THERMAL FLUX
KEVLER	340249	108E7	28178	112E7
L031	351351	534E8	274751	569E8
RP01	351351	858E8	274751	890E8

VI. CONCLUSION

In the analysis part the model analyzed two stages which are structural and thermal with 3 different frictional materials.

By comparing the results:

- **Actual model structural & thermal results:**
  1. Actual model with Kevlar friction material stress values less compared to L031 & RP01.
  2. In the thermal also actual model with Kevlar friction material thermal flux values less compared to L031 & RP01.

So we conclude that Kevlar is the best material for the original model.

- **Modified model structural & thermal results:**
  1. Modified model with Kevlar friction material stress values less compared to L031 & RP01.
  2. In the thermal also actual model with Kevlar friction material thermal flux values less compared to L031 & RP01.

So we conclude that Kevlar is the best material for the modified model.

- **Comparing the actual model structural & thermal values with the modified model**
  Modified model stress values are less compared actual model similarly modified

model thermal flux results are less compared to actual model.

So finally conclude that modified model can be used in the place of actual model and the used friction material is Kevlar.

References:

[1]. Desai C S and J F Wilson, *Numerical method in FEA*, Prentice-Hall of India Private limited, New Delhi, 1978.
[2]. Strang G and B J F ix, *An Analysis of the finite element method*, prentice Hall, Englewood cliffs,N.J,1973.
[3]. Desai C S and J F Abel, *Introduction to the Finite Element method*, Affiliated East-West press pvt. Ltd., New Delhi, East West student Edition, 1977.
[4]. Crandall S H , *Engineering Analysis*, Mc Graw- Hill, New York,1956.
[5]. Timoshenko S., *Element of Strength of Materials*, Part I and II, Van Nastrond , New Jersey, 1956.
[6]. Timoshenho S. and J.N.Goodier, Theory *of Elasticity*, Mc Graw-Hill, New York,1970.
[7]. Richards, T H, Energy *Methods in Structural Analysis with an Introduction to Finite Element Techniques*, Ellis Harwood Ltd., Chichester,1977.
[8]. Anil Jadhav, Gauri Salvi, Santosh Ukamnal, Prof.P.Baskar, "Static Structural Analysis of Multiplate Clutch with Different Friction Materials", International Journal of Engineering Research & Technology, Vol. 2, Issue 11, November – 2013.
[9]. Ganesh Raut, Anil Manjare, P Bhaskar, "Analysis of Multidisc Clutch Using FEA", International Journal of Engineering Trends and Technology, Volume 6 (Number 1- Dec 2013).
[10]. Sagar Olekar, Kiran Chaudhary, Anil Jadhav, P.Baskar, " Structural analysis of multiplate clutch", IOSR Journal of Mechanical and Civil Engineering, Volume 10, Issue 1 (Nov. - Dec. 2013).