STRUCTURAL AND THERMAL FEA ANALYSIS OF WET MULTI PLATE CLUTCH BY VARYING FRICTION SURFACE MATERIALS

Mahesh Kumar Sah* and Mahendran Kumar*

* M.E, CAD/CAD Student, Indira Institute of Engineering and technology, thiruvalluvar, India
* M.E, Assistant-Professor, Indira Institute of Engineering and technology, thiruvalluvar, India

Abstract— In this present paper, we design Wet clutch by Computational Modeling and z-D drawings are designed for multi plate clutch from computational calculations. 3D model model is created in the CATIA modeling software for pulsar 150cc bike. We have done FEM analysis by varying friction materials with some non metals and composite materials we are going to find out which material is best suited for the lining of friction surfaces. Structural Analysis is done by using ANSYS-WORKBENCH software.

Index Terms— Ansys, CATIA, Copper, Cork, SF001, SF-BU, Wet-Clutch plate, Vonmises stress, Vonmises strain, Total Deformation.

I. INTRODUCTION

It is an instrument for transmitting pivot, which can be locked in and withdrew. Grasps are valuable in gadgets that have two turning shafts. In these gadgets, one pole is commonly determined by an engine or pulley, and the other shaft. drives another gadget. Give us a chance to take an occurrence where one pole is driven by an engine and alternate drives a drill toss. The grip associate the two poles so they can either be bolted together and twist at the same rate (drew in), or be decoupled and turn at diverse paces.

A. Friction Clutches:

The contact friction clutch is an imperative part of any car machine. It is a connection in the middle of motor and transmission framework which directs power, in type of torque, from motor to the apparatus gathering At the point when vehicle is begun from halt grasp is locked in to exchange torque to the transmission; and when vehicle is in movement grip is initially separated of the drive to consider rigging determination and afterward again connected with easily to control the vehicle.

II. MATERIAL SELECTION FOR MULTI-PLATE CLUTCH

The materials utilized for the covering of grating surface of a grip called rubbing material f grinding coating materials, Qualities of the grating covering are as taking as follows:

1. It could have a high and uniform coefficient of grating under working conditions
2. It could not be influenced by dampness and oil
3. It have to able to withstand high temperature brought about because of slipping
4. It could to have high imperviousness to wear impacts, for example, scoring, irking, and removal.
5. It could to have less push and strains.
6. It should to with stand load with less aggregate displacement.
7. It have to support of erosion properties amid whole living up to expectations life.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Properties</th>
<th>Young’s Modulus (Mpa)</th>
<th>Poisson’s Ratio</th>
<th>Density (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cork</td>
<td>32</td>
<td>0.25</td>
<td>180</td>
</tr>
<tr>
<td>2</td>
<td>Copper Powder Metal</td>
<td>135e³</td>
<td>0.35</td>
<td>8300</td>
</tr>
</tbody>
</table>
A. Modeling of Wet Clutch

CATIA is software which is used for creation and modifications of the objects. In CATIA and design and modeling feature is available. Design means the process of creating a new object or modifying the existing one. Drafting means the representation or idea of the object. Modeling means converting 2D to 3D.

This is most progressive geometric demonstrating in three measurements. This regularly utilizes strong geometry shapes called picture to build the article. Another element of the CATIA framework is shading design capacity. By method for shading, it is conceivable to show more data on the representation screen hued pictures help to illuminate parts is a gathering or highlight measurements or host of different purposes.

By utilizing the basic capacities of the product as to the single information source standard, it gives a rich arrangement of apparatuses in the assembling environment as tooling plan and recreated CNC machining and yield. Tooling choices spread forte instruments for embellishment; pass on throwing and dynamic tooling outline.

III. COMPUTATIONAL MODELLING

1. Power produced in Bike = 9000 rpm
2. Twisting Moment = 12.45 N-m @ 6500rpm
3. Co-efficient of friction in between the friction plates, \( \mu = 0.3 \)
4. Operating temperature in between plates\(^\circ\)C = 150 – 250
5. Maximum pressure applied N/mm\(^2\) = 0.4
6. \( r_1 \) and \( r_2 \) outer and inner radius of friction faces \( r_1 = 109 \text{ mm} \) and \( r_2 = 90 \text{ mm} \)
7. Average Uniform Pressure=0.0045867Mpa.
8. Generation of Heat \( Q_g = 2187.5 \) Joules
IV. FINITE ELEMENT ANALYSIS

Finite Element Analysis was initially produced for utilization in the aviation and atomic commercial enterprises where the security of the structures is discriminating. Today, the development in use of the strategy is straightforwardly owing to the quick advances in PC innovation lately. Accordingly, business Finite Element bundles exist that are fit for tackling the most advanced issues, not simply in Structural Analysis. In any case, for an extensive variety of utilizations, for example, relentless state and transient temperature appropriations, liquid stream reproductions furthermore recreation of assembling procedures, for example, Injection Molding and Metal framing. The finite element method is a powerful tool to obtain the numerical solution of wide range of engineering problems. The method is general enough to handle any complex shape or geometry, for any material under different boundary and loading conditions.

A. Advantages of FEM

The properties of each element are evaluated separately, so an obvious advantage is that we can incorporate different material properties for each element. Thus almost any degree of non-homogeneity can be included. There is no restriction on to the shape of medium; hence arbitrary and irregular shapes cause no difficulty like all numerical approximations FEM is based on the concept of description. Nevertheless as either the variations or residual approach, the technology recognizes the multidimensional continuous but also requires no separate interpolation process to extend the approximate solution to every point with the continuum.

B. Limitations of FEM

FEM reached high level of development as solution technology; however the method yields realistic results only if coefficient or material parameters that describe basic phenomena are available.

The most tedious aspects of use of FEM are basic process of sub-dividing the continuum of generating error free input data for computer.

C. Applications of FEM

Referring to temperature or heat flux distribution in the case of heat transfer problem. Referring to Eigen value problems in solid mechanics or structural problem, natural frequencies, buckling loads and mode shapes are found, stability of laminar flows is found if it is a fluid mechanics problem and resonance characteristics are obtained if it is an electrical circuit problem, while for the propagation or transient problem, the response of the body under time varying force is found in the area of solid mechanics.

D. Structural Analysis

This analysis is performed to perform to find Structural parameters such as Stresses, Strains,Deformation, Bending Moment and Shear stress. Structural analysis is probably the most common application of the finite element method as it implies bridges and buildings, naval, aeronautical, and mechanical structures such as ship hulls, aircraft bodies, and machine housings, as well as mechanical components such as pistons, machine parts, and tools.

Fig.6.Clutch plate is imported into ANSYS-WORKBENCH.

Fig.7. Meshing of Clutch plate in ANSYS-WORKBENCH.
Fig. 8. Boundary Condition’s applied to Clutch plate

Fig. 9. Loads applied on Wet-Multi plate clutch.

Fig. 10. Vonmises stress acting on Cork Clutch plate.

Fig. 11. Total deformation acting on Cork Clutch plate.

Fig. 12. Vonmises stress acting on Copper Clutch plate.

Fig. 13. Total deformation acting on Copper Clutch plate.
Fig. 14. Vonmises stress acting on SF001 Clutch plate.

Fig. 15. Total deformation acting on SF001 Clutch plate.

E. Thermal Analysis:

Thermal Analysis is performed to find Temperature distribution and Heat flux over the surface of the Clutch plate. Transient Thermal analysis i.e. Temperature is going to varied w.r.to time is performed.

Fig. 16. Boundary conditions applied for Clutch plate in Thermal analysis.

Fig. 17. Heat flux given as load.

Fig. 18. Temperature Distribution over entire surface of cork friction plate.
Fig. 19. Heat flux Distribution over entire surface of cork frictionplate.

Fig. 20. Temperature Distribution over entire surface of copper frictionplate

Fig. 21. Heat flux over entire surface of copper frictionplate

Fig. 22. Temperature Distribution over entire surface of SF001 frictionplate

Fig. 23. Heat flux over entire surface of SF001 frictionplate

TABLE

Results Obtained From Structural Analysis

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameters</th>
<th>Cork</th>
<th>Copper</th>
<th>SF001</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Von-Mises Stress (Mpa)</td>
<td>0.00927</td>
<td>0.00871</td>
<td>0.0081</td>
</tr>
<tr>
<td>3.</td>
<td>Total Deformation (mm)</td>
<td>0.00052</td>
<td>1.5557e⁻⁷</td>
<td>4.0258e⁻⁶</td>
</tr>
<tr>
<td>4.</td>
<td>Temperature Distribution (°C)</td>
<td>295.2</td>
<td>252.3</td>
<td>176.6</td>
</tr>
<tr>
<td>5.</td>
<td>Heat Flux (W/mm²)</td>
<td>0.0004801</td>
<td>0.054524</td>
<td>0.057216</td>
</tr>
</tbody>
</table>

The above qualities are the most extreme results demonstrated by ansys among the all the acquired results.

F. Graphs:
V. CONCLUSION

Modeling of Multiplate clutch is done by using CATIAV5 Software and then the model is imported into ANSYS Software for Structural, Thermal analysis on the Multi plates to check the quality and temperature circulation of distinctive friction materials such as cork, copper (powder metal), SF001 composite material.

From the investigation, the obtained Vonmises stresses for the materials cork, copper and SF001 are 0.0092703 Mpa, 0.0087186 Mpa and 0.0081038 Mpa respectively. From that it is known that the SF001 material induces less stress value of 0.0081038 Mpa.

Total deformation values obtained from the analysis for the materials cork, copper and SF001 are 0.00052169, 1.5557e-3 and 4.0258e-6 respectively. Hence it is known that the strength of SF001 powder material for multiplate clutch is improved to resist the erosion and lowers the Total deformation.

Temperature dispersion is diminished from m295.2°C to 176.6°C and heat flux additionally enhanced such that mechanical properties of friction plate and life time of the friction clutch are better improved.

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Mahesh Kumar Sah, PG Student Cad/Cam, Indira Institute of Engineering and Technology, Thiruvallur, Tamilnadu.
Mahindran Kumar, M.E, Assistant-Professor, Indira Institute of Engineering and Technology research work, membership, achievements, with photo that will be maximum 200-400 words.