Design and Evaluation of Multi plate clutch Profiles for Light Weight Vehicles using FEA

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***Abstract*—** In this present paper, we design Wet clutch by Computational Modelling and 2-D drawing's are designed for multiplate clutch from computational calculations.3D model model is created in the CATIA modeling software for FZ bike. Structural Analysis is performed for multi plate clutch by finite element analysis (FEA) software package Ansys. Materials used for liner is Cork , Copper Powder metal, SF001 composite Material. Comparison will perform between existing design and newly designed clutch profile to validate better design under the different load conditions while changing the gears with low cost and reduction in stresses and deformation.

***Keywords*— Ansys, CATIA, Copper, Cork, SF00, 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.

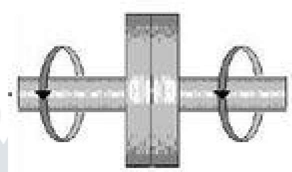


Fig.1.Engaged position of Wet-Clutch Plate

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 be 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 I
Material Properties

S.No	Properties	Young's Modulus (Mpa)	Poisson's Ratio	Density (kg/m^3)
1	Cork	32	0.25	180
2	Copper Powder Metal	135e^3	0.35	8300
3	Sf001	7000	0.49	1350

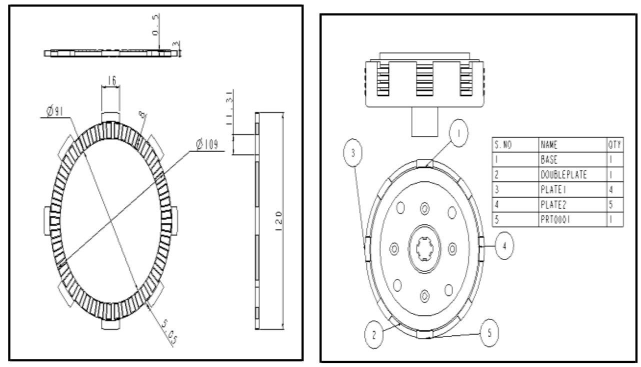


Fig.3. 2-D representation of Friction-Plate and Assembly of Clutch.

III. 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.

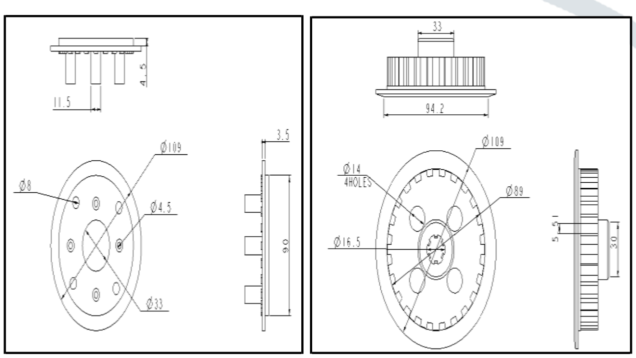


Fig.2 2-D representation of Base-Part and Double plate.

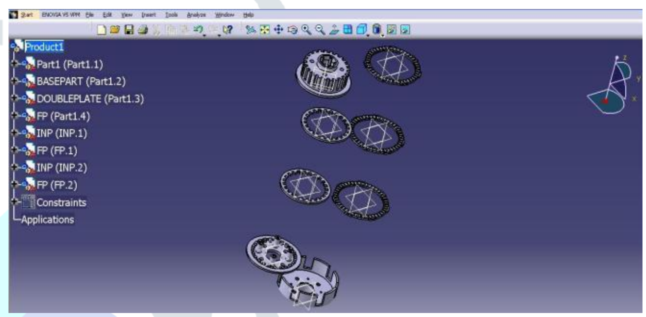


Fig.4. 3-D representation of Exploded View of Wet Multi-plate Clutch.

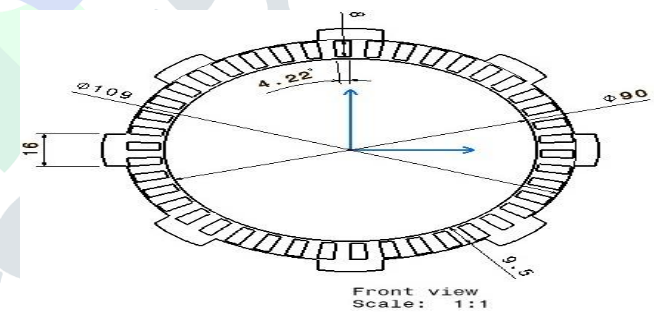


Fig.5. 2-D representation of straight profile Wet Multi-plate Clutch.

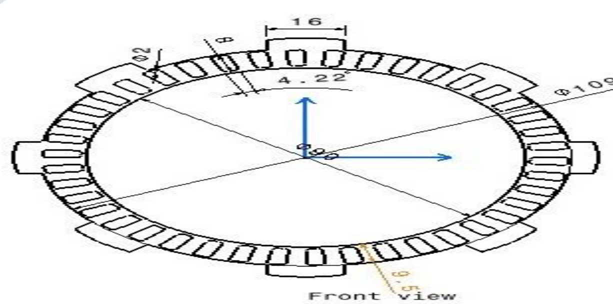


Fig.6. 2-D representation of Fillet profile Wet Multi-plate Clutch

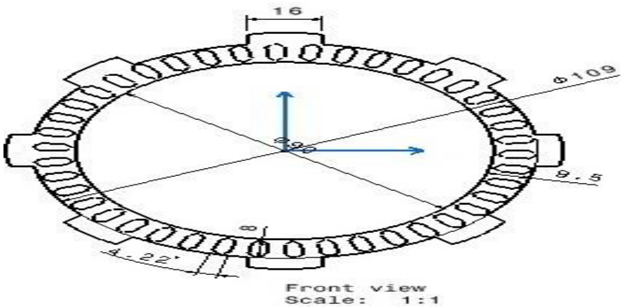


Fig.7. 2-D representation of Chamfer profile Wet Multi-plate Clutch

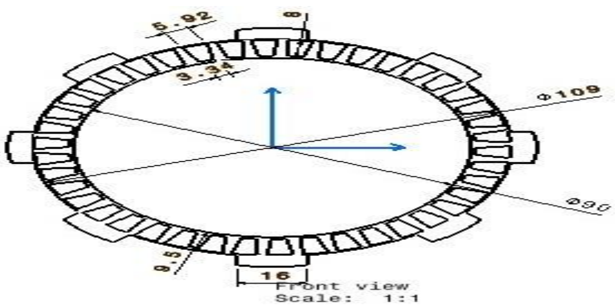


Fig.8. 2-D representation of Tapered profile Wet Multi-plate Clutch

A. Advantages of FEM

IV. Computational Modelling

1.Power produced in Bike = 10000 rpm

2.Twisting Moment = 19.2 N-m @ 8000rpm

3.Co-efficent of friction in between the friction plates, μ = 0.3

4.Operating temperature in between plates°C = 150 – 250

5.Maximum pressureapplied N/mm^2 = 0.4

6. $r_1$and r_2 outer and inner radius of friction faces r_1 =109mm and r_2 = 90 mm

7. Average Uniform Pressure=0.0070735Mpa.

V. 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

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.

D. Structural Analysis

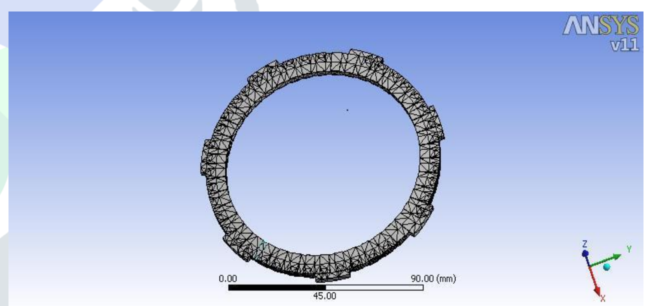


Fig.9.Meshing of Rectangle edge Clutch plate in ANSYS

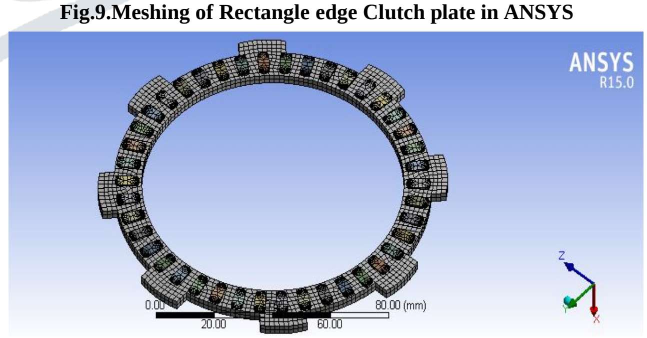


Fig.10.Meshing of Fillet edge Clutch plate in ANSYS

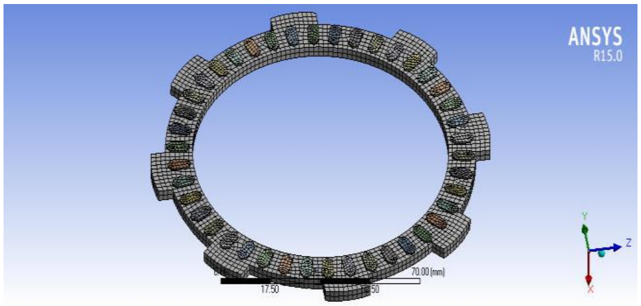


Fig.11.Meshing of Chamfer edge Clutch plate in ANSYS

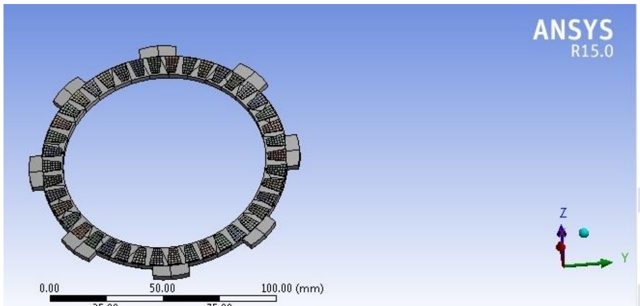


Fig.12.Meshing of Taper edge Clutch plate in ANSYS

TABLE II

NODES & ELEMENTS OF CLUTCH PLATES

S.No	Profile	Nodes	Elements
1	Rectangle	29627	4078
2	Fillet	92537	11868
3	Chamfer	38323	5286
4	Taper	20115	2189

This analysis is used 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.

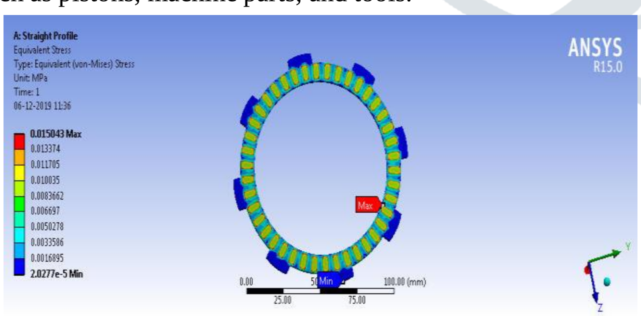


Fig.13.Vonmises Stress of Cork Rectangle Plate

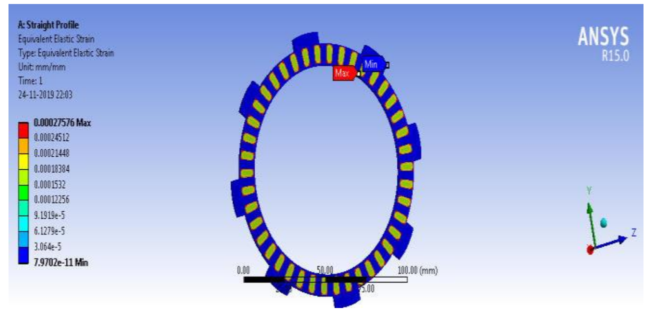


Fig.14.Vonmises Strain of Cork Rectangle Plate

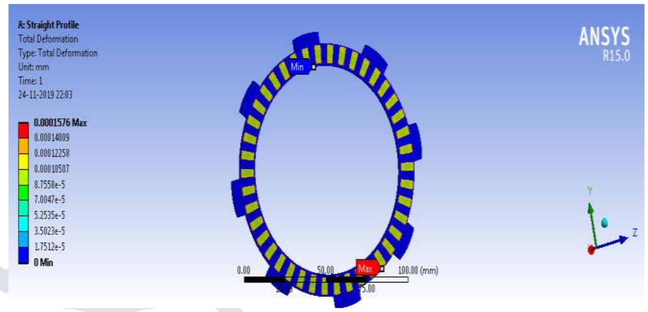


Fig.15. Total Deformation of Cork Rectangle Plate

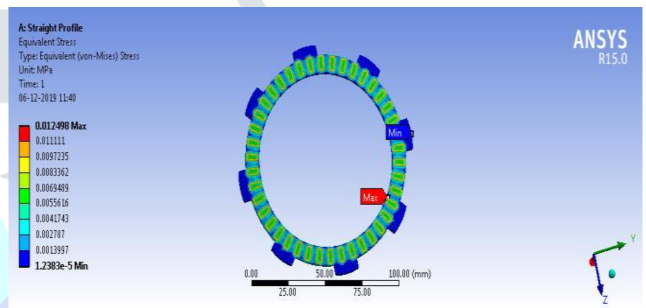


Fig.16. Vonmises Stress of Copper Rectangle Plate

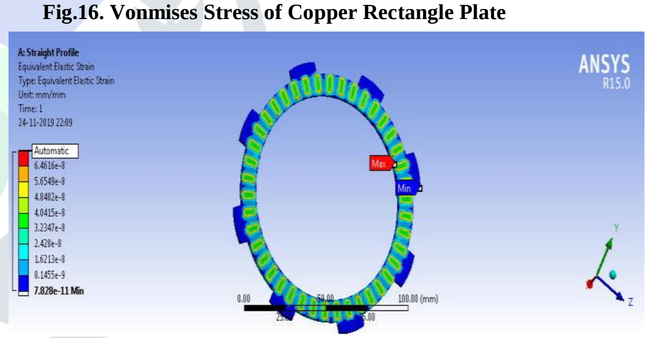


Fig.17. Vonmises Strain of Copper Rectangle Plate

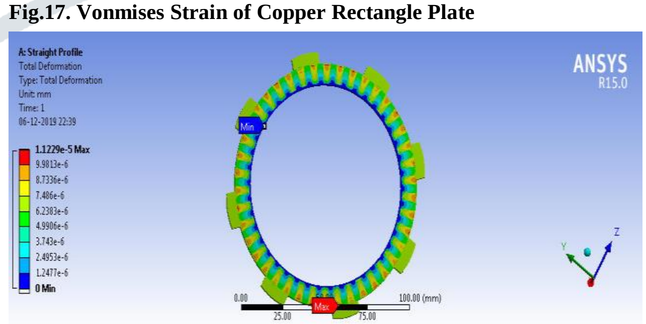


Fig.18. Total Deformation of Copper Rectangle Plate

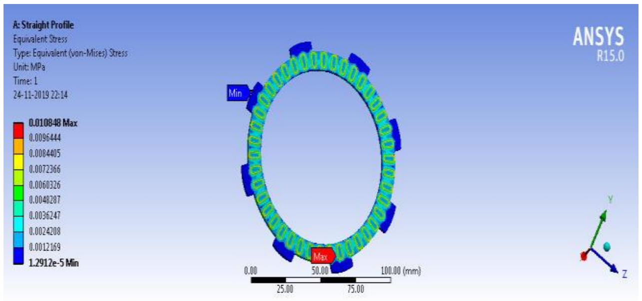


Fig.19. Vonmises Stress of SF001 Rectangle Plate

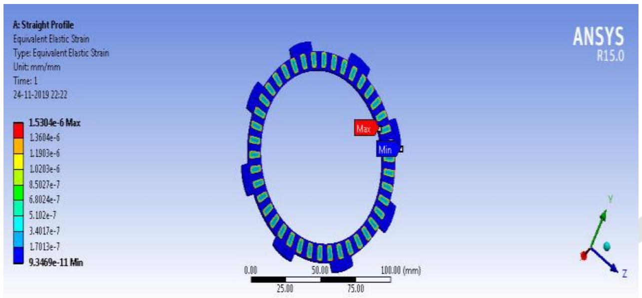


Fig.20. Vonmises Strain of SF001 Rectangle Plate

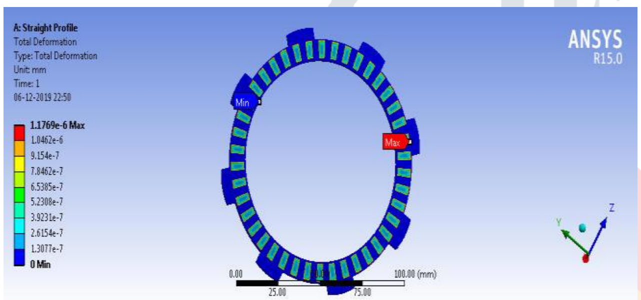


Fig.21. Total Deformation of SF001 Rectangle Plate

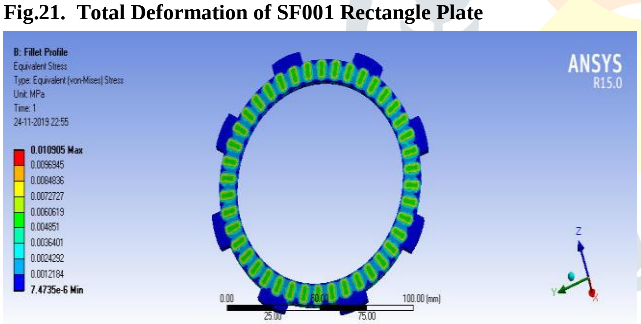


Fig.22. Vonmises Stress of Cork Fillet Plate

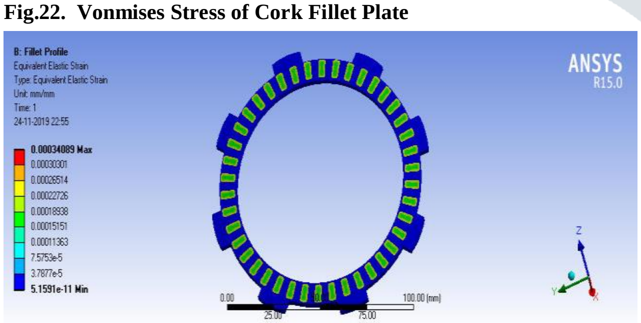


Fig.23. Vonmises Strain of Cork Fillet Plate

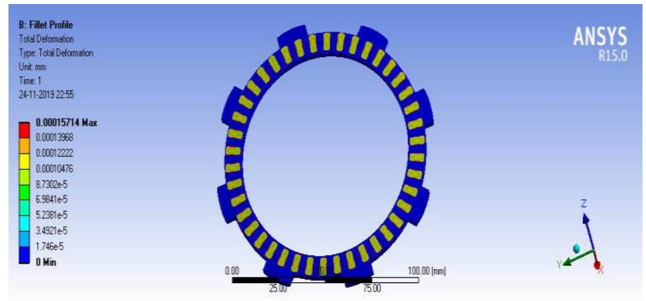


Fig.24. Total Deformation of Cork Fillet Plate

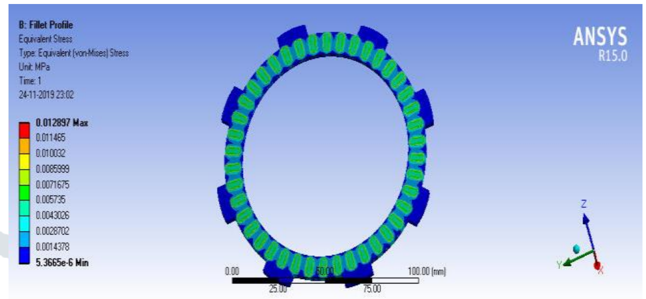


Fig.25. Vonmises Stress of Copper Fillet Plate

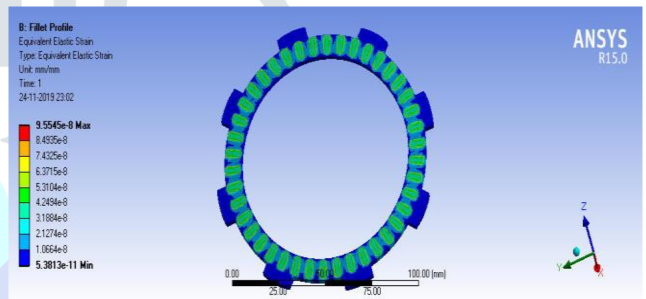


Fig.26. Vonmises Strain of Copper Fillet Plate

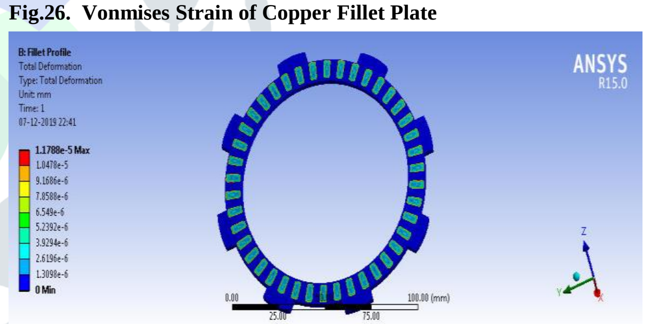


Fig.27. Total Deformation of Copper Fillet Plate

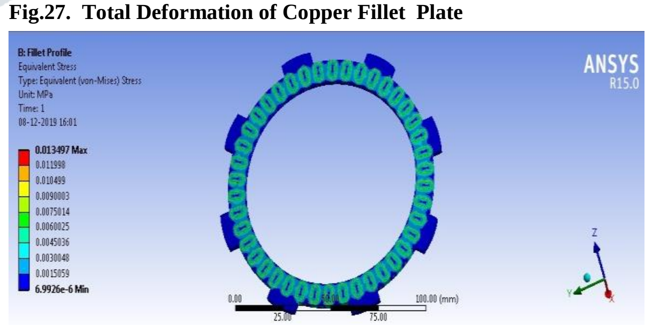


Fig.28. Vonmises stress of SF001 Fillet Plate

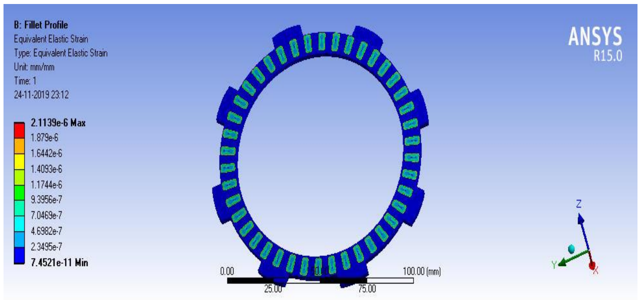


Fig.28. Vonmises strain of SF001 Fillet Plate

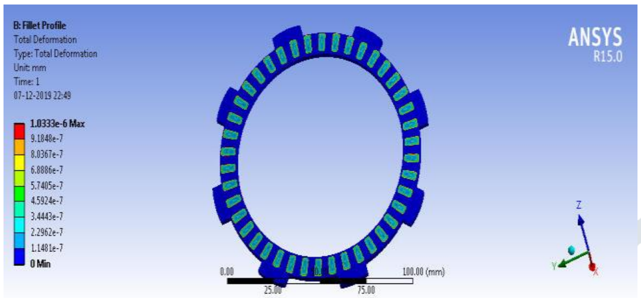


Fig.29. Total Deformation of SF001 Fillet Plate

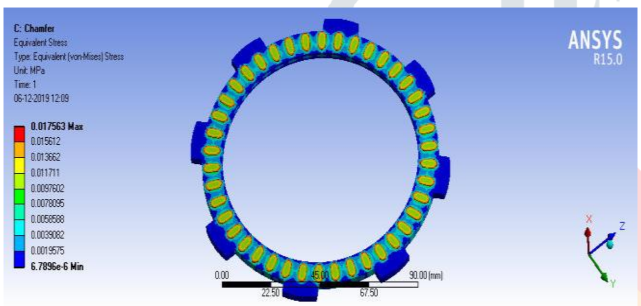


Fig.30. Vonmises Stress of Cork Chamfer Plate

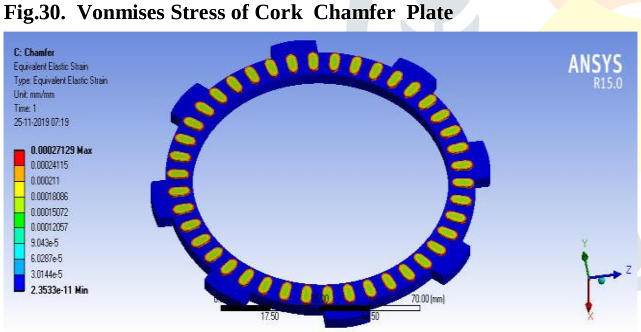


Fig.31. Vonmises Strain of Cork Chamfer Plate

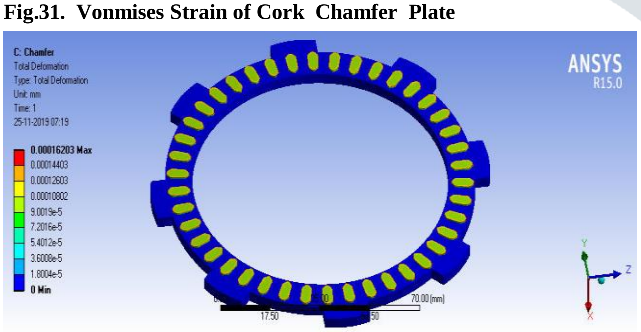


Fig.32. Total Deformation of Cork Chamfer Plate

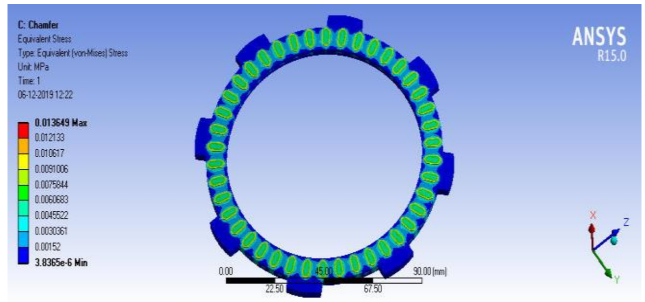


Fig.33. Vonmises Stress of Copper Chamfer Plate

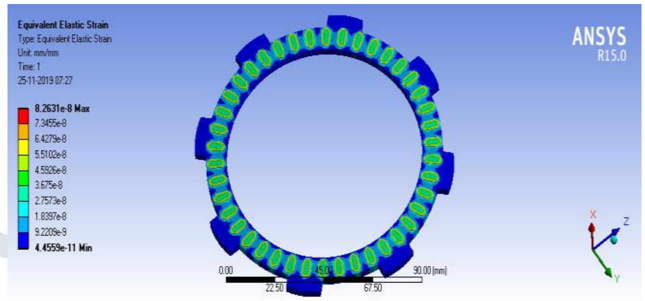


Fig.34. Vonmises Strain of Copper Chamfer Plate

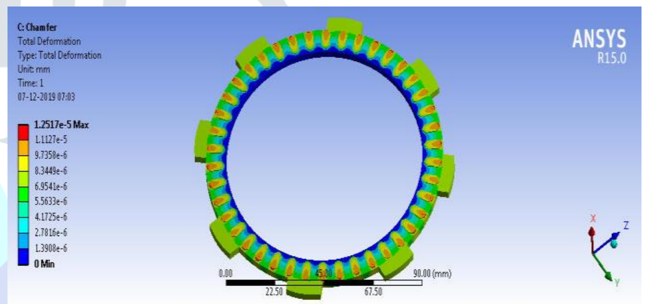


Fig.35. Total Deformation of Copper Chamfer Plate

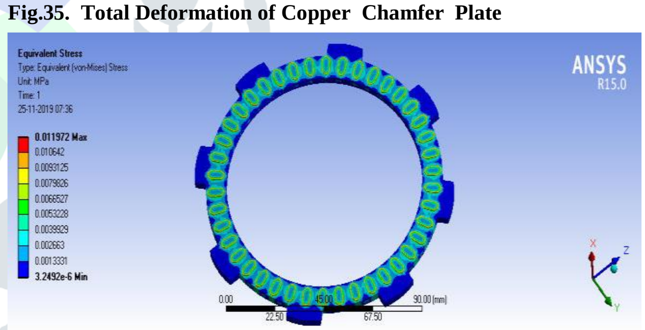


Fig.36. Vonmises Stress of SF001 Chamfer Plate

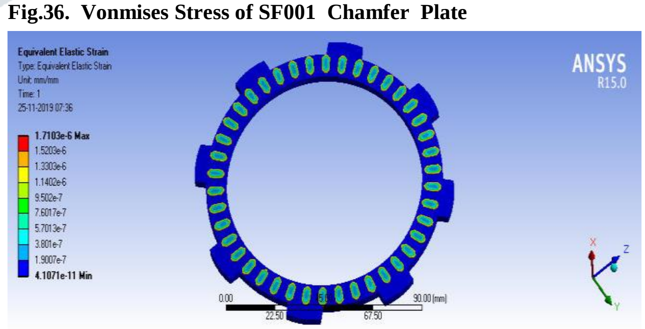


Fig.37. Vonmises Strain of SF001 Chamfer Plate

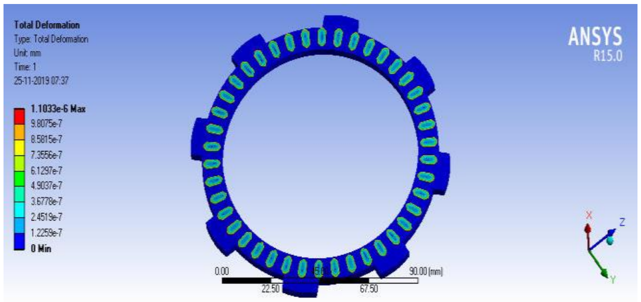


Fig.38. Total Deformation of SF001 Chamfer Plate

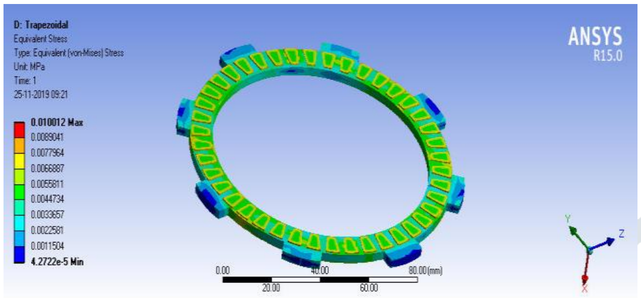


Fig.39. Total Deformation of SF001 Chamfer Plate

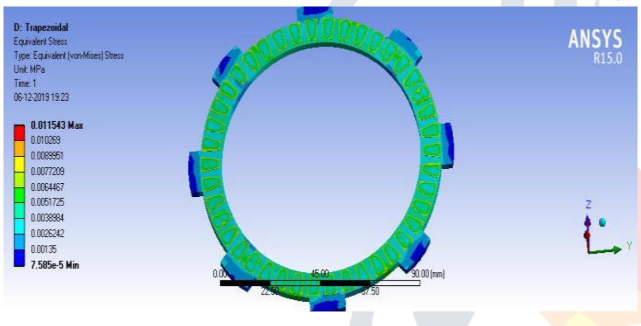


Fig.40. Vonmises Stress of Cork Taper Profile Plate

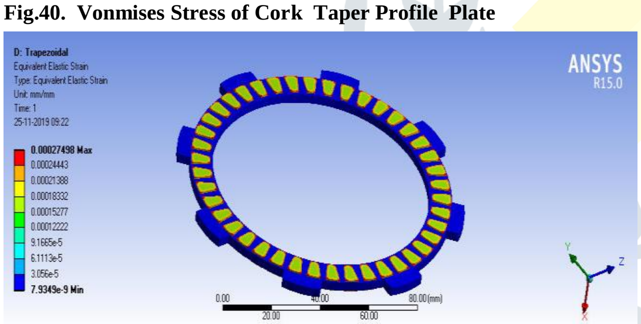


Fig.41. Vonmises Strain of Cork Taper Profile Plate

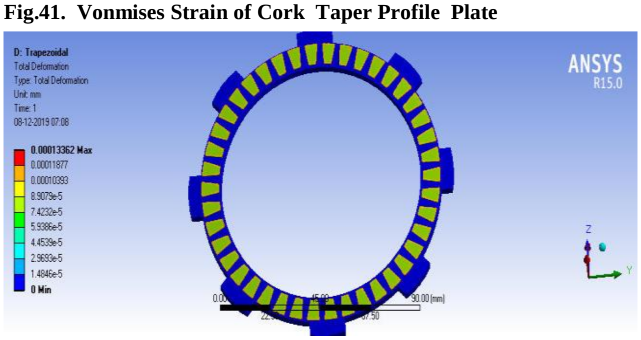


Fig.42. Total Deformation of Cork Taper Profile Plate

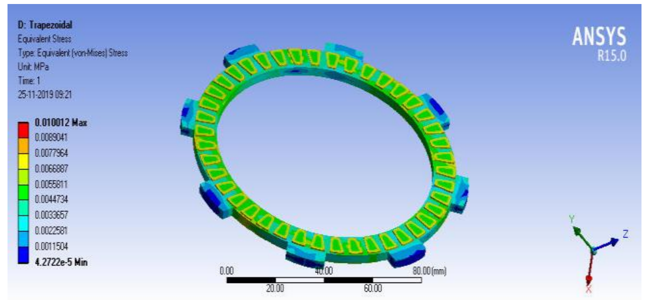


Fig.43. Vonmises Stress of Copper Taper Profile Plate

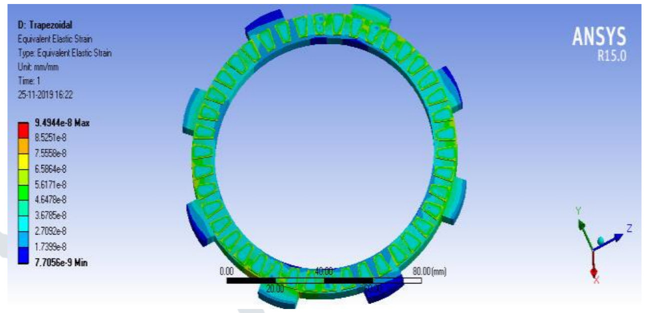


Fig.44. Vonmises Strain of Copper Taper Profile Plate

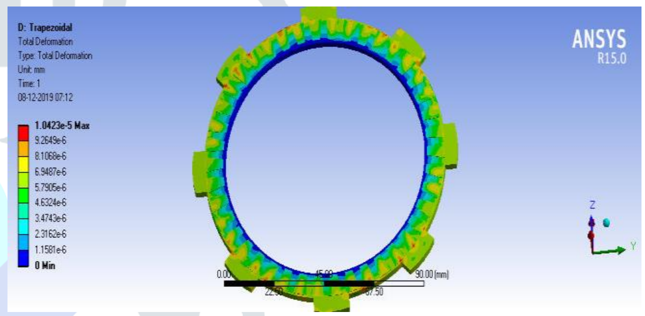


Fig.45. Total Deformation of Copper Taper Profile Plate

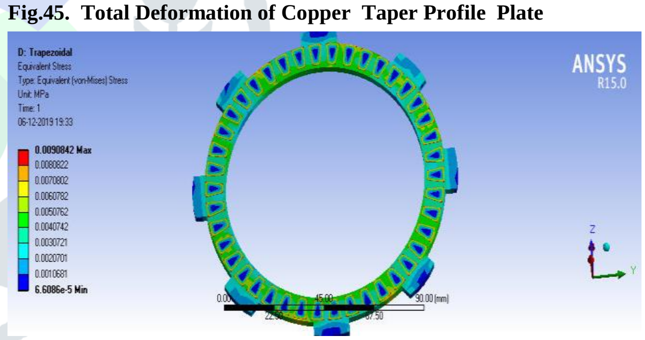


Fig.46. Vonmises stress of SF001 Taper Profile Plate

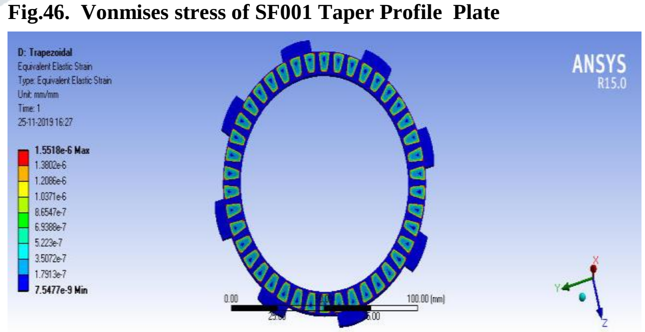


Fig.47. Vonmises strain of SF001 Taper Profile Plate

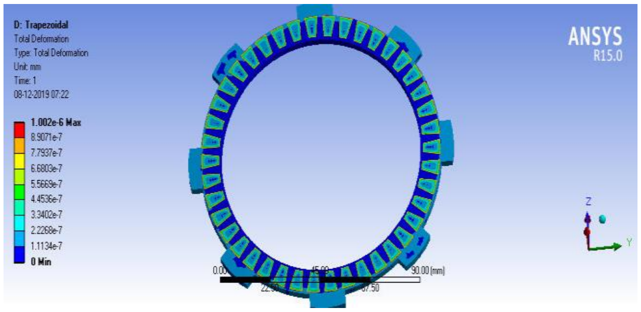


Fig.48. Total Deformation of SF001 Taper Profile Plate

TABLE III
VONMISES STRESS FROM STRUCTURAL ANALYSIS

S.NO	PROFILE	Vonmises Stress-Mpa		
		Cork	Copper	SF001
1	Rectangle	0.01504	0.01249	0.010848
2	Fillet	0.010905	0.012897	0.013497
3	Chamfer	0.017563	0.013649	0.011972
4	Taper	0.011543	0.010012	0.0090842

TABLE IV
VONMISES STRAIN FROM STRUCTURAL ANALYSIS

S.NO	PROFILE	Vonmises Strain		
		Cork	Copper	SF001
1	Rectangle	0.0002757	7.2684e-8	1.5304e-6
2	Fillet	0.00034089	9.5545e-8	2.1139e-6
3	Chamfer	0.00027129	8.2631e-8	1.7103e-6
4	Taper	0.00027498	9.4944e-8	1.5518e-6

TABLE V
TOTAL DEFORMATION FROM STRUCTURAL ANALYSIS

S.NO	PROFILE	Total Deformation-mm		
		Cork	Copper	SF001
1	Rectangle	0.000157	1.229e-5	1.1769e-6
2	Fillet	0.0001571	1.1788e-5	1.033e-6
3	Chamfer	0.000162	1.2517e-5	1.1033e-6
4	Taper	0.00013362	1.0423e-5	1.002e-6

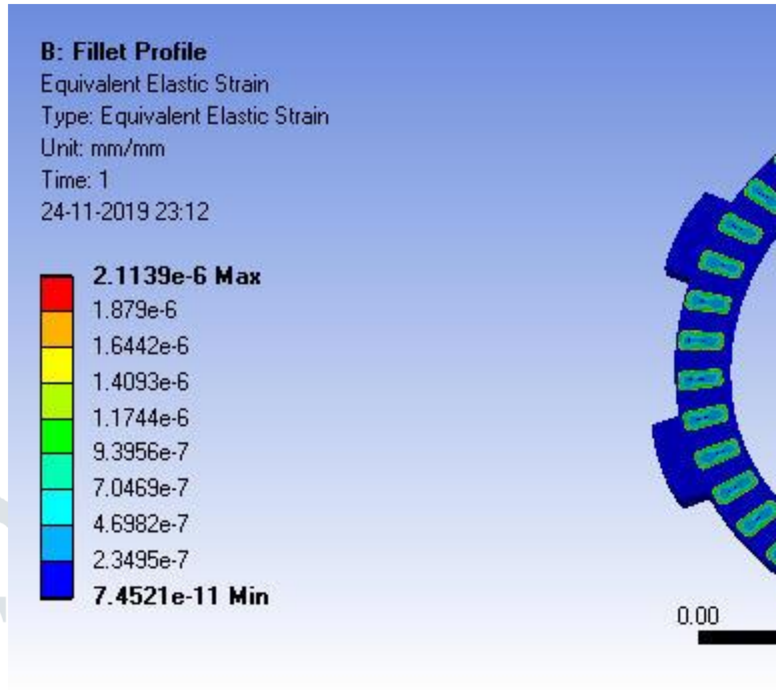
VII. CONCLUSION

Computational configuration analytical investigation and Structural analysis done on the friction plates to check the quality Friction materials, for Cork , Copper(powder metal) and SF001 Composite materials. By watching the investigation results Taper profile got better values such as Vonmises stress and Total Deformation then Rectangle, Fillet and chamfer profiles and SF001 Vonmises stress 0.011543Mpa, Total Deformation 1.002e-6. Composite material got better results then Cork and Copper SF001 material liners.

REFERENCES

[1] Karl Friedrich Benz has created the first business gas fueled vehicles, the acclaimed Tri-Cycle, he likewise was the first individual to concoct and utilize the grasp framework to the auto,1885

[2] Exedy and Daikin, Exedy Corp., it was accounted for that when Karl Benz has created the first business gas fueled vehicles, the acclaimed Tri-Cycle, he likewise was the first individual to concoct and utilize the grasp framework to the auto,1918.



[3] S. Jaya Kishore, M. Lava Kumar" Structural Analysis Of Multi-Plate Clutch" International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 7–July 2013.

[4] Uma Mahesh, Bhaskar Reddy, Jaya Kishore., "Computational Geometric Modeling and Finite Elmenet Structural Analisys of Automobile Camshaft", www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 7, July 2015)

[5] Matveev and Pustovalov Designed a numerical reproduction for stream Between annular circles by utilizing an unequivocal preservationist plan for the Navier- Stokes mathematical statements,1982.

[6] Zlatomir zivanovic, Miodrag Milic –Thermal Loadof Multi-disc wet friction Assemblies at Braking Regime‖ Strojniski vestnik-Journal of Mechanical Engineering,2011.

[7] Oday I.Abdullah, Josef Schlattmann , – Finite Element Analysis for Grooved Dry Friction Clutch‖ AMEA,Vol.2,No.1, ISSN 2167-6380.

[8] S. Abdul Mutalib, S. Suresh, S.Jaya Kishore, Design and Analysis of Composite Marine Propeller using ANSYS WORK BENCH, International Journal of Science, Engineering and Technology Research (IJSETR), 4, 2015,pp. 3224-3228.

[9] Sagar Olekar, Kiran Chaudhary,Anil jadhav, P.Baskar‖ Structural analysis of multi-plate clutch‖ IJERT-Volume5,Issue-7-November 2013.