International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Design and Analysis of Disc Brake using ANSYS

M.Iyyappan, M.Robert Paul, S.Nirmal Moses, J.Yasin

***Abstract*: Braking is a procedure that changes over the kinetic vitality of a vehicle into mechanical vitality, which must dissipate heat. A brake plate generally made of cast iron or clay composites is connected to the wheel. The friction material of brakes (i.e) brake cushions is upheld precisely by using pressurized water, pneumatically or electromagnetically to the two sides of the plate which holds the wheel. The present examination basically manages the modeling and breaking down a ventilated circle brake by Solid works and ANSYS. FE models of the brake are molded with solid works and reproduced by utilizing ANSYS which depends on the finite element technique (FEM). This thermal investigation is done as such as to get the quality of the brake. The suitable design is found and heat flow rates and heat fluxes in the thermal examination, are considered by fluctuating the cross segments and materials of the disc brake rotor.**

***Index Terms*: Braking system, Thermal Analysis, Disc Brake, ANSYS.**

I. INTRODUCTION

Braking is a strategy which changes over the kinetic vitality of a car into mechanical vitality, which must dissipates the heat. A brake disc typically made of cast iron or clay composites, is connected to the wheel. The type of brake cushions is upheld precisely, using pressurized water, pneumatically or electromagnetically to the two sides of the disc and holds the wheel. The present investigation basically manages the demonstrating and dissecting ventilated circle brake by solid works and ANSYS. A brake is a machine which creates non-common frictional opposition on a moving gadget component to anticipate the movement of a machine. In this strategy the brakes take up either kinetic vitality of the moving component or the potential vitality surrendered by objects being brought down by hurls lifts. The vitality dazzled by disc brake is debauched as heat. This heat is dispersed into the including atmosphere to stop the vehicle, so an ideal halting instrument should have the following essentials: (i). The brakes must be sufficiently able to stop the vehicle with in a base Distance in a crisis. (ii). The driver must have appropriate power over the vehicle during braking and the vehicle must not slide. (iii). The brakes must have great subterranean insect blur qualities for example their adequacy ought not to diminish with consistent delayed application (iv). The brakes ought to have great wear properties.

To improve the productivity and the propensity to give security braking to vehicles, for example, bicycles, autos and so forth, we need an appropriate structure to chip away it. FE models of the brake-plate are formed with strong works and recreated utilizing ANSYS which depends on the FEM technique. This thermal investigation is done as such as to get the quality of the brake. The suitable design is found and heat flow rates and heat fluxes in the thermal examination, are considered by fluctuating the cross segments and materials of the disc brake rotor.

Upon taking the conventional and proposed design for disc of the disc brake we can analyze and compare factor such stress, deflection, temperature, heat flux etc, to find a perfect disc for our brake.

II. DESIGN CALCULATION

The rotor replica heat flux is considered for the automobile speeding with a velocity of 100km/h and the below is the calculations.

Procedure and Data:

Mass of the vehicle = 132 kg

(u)= 27.77 m/s (100 km/h)

Speed after braking (v) = 0 m/s

g =9.81m/s2

Coefficient of friction for dry pavement μ=0.45

Diameter of the rotor disc- 241mm

Tangential force between the brake pad and rotor:

FTRI= normal force between brake pad and rotor

μ = coefficient of friction = 0.5

A = pad brake area = 0.0067 m2

FTRI = μ.FRI ----------- EQ (1)

FRI = (Pmax /2) ×A --------EQ (2)

FTRI = μ.FRI

FTRI = 0.5 × 0.5 × 1E6 × 0.0067 = 1675N

Take, FTRI x 2 = 3350 N for ansys calculation. 52

Tangential force between the pad and rotor is equal to FTRI because of the same normal force and material.

Brake torque Tb = FT.R

FT is the normal forces on the disc brake = 1675N

R is the radius of the rotor

Tb = FT.R = 1675 × (120× 10e-3) = 201NM

Manuscript published on November 30, 2019.

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III. ANALYSIS OF DISC ROTOR

A. *Conventional Design Analysis for cast iron*

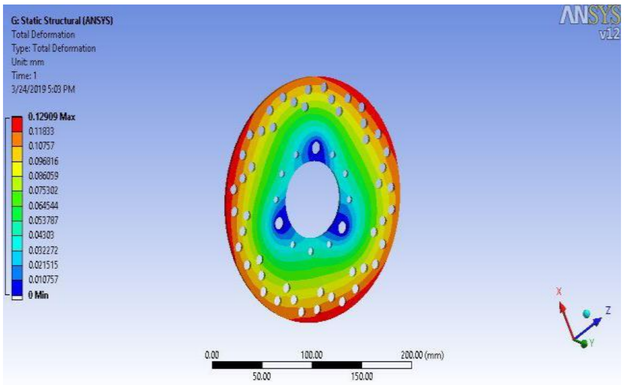

Fig 1 CI Deformation

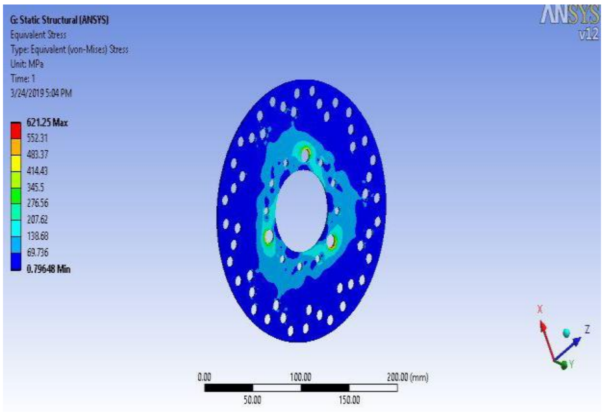

Fig 2 Stress

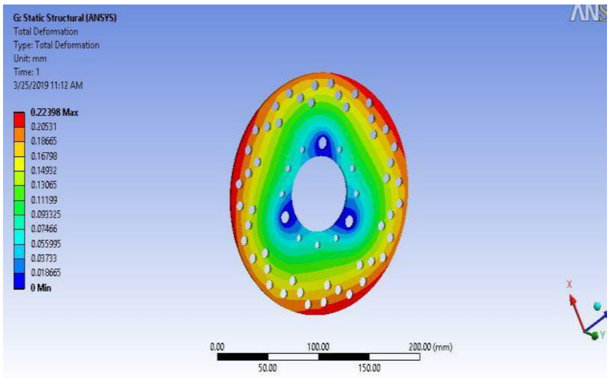

Fig 3 Temperature

B. *Conventional Design Analysis for aluminium*

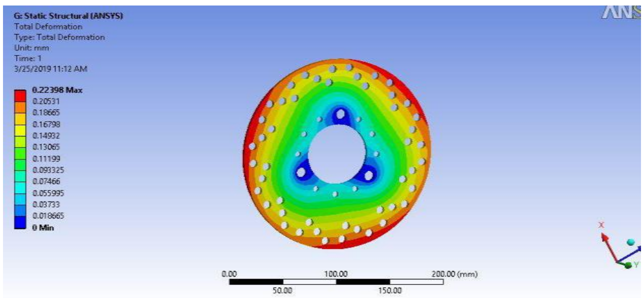

Fig 4 Al Deformation

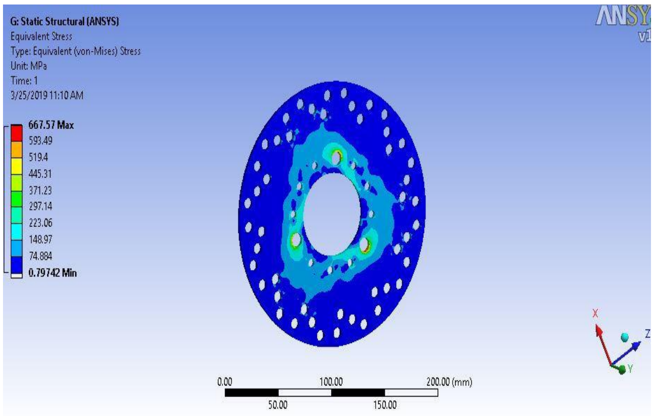

Fig 5 Stress

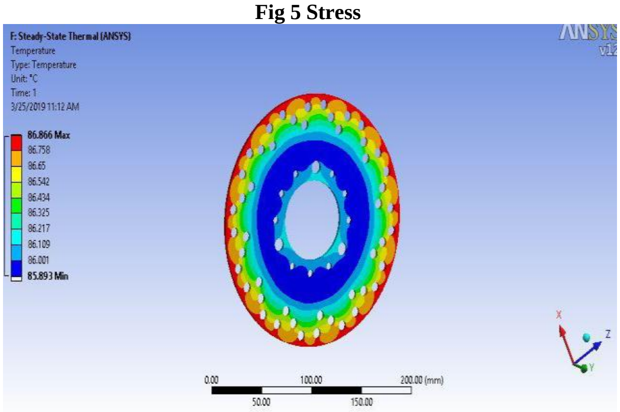

Fig 6 Temperature

C. *Proposed design analysis*

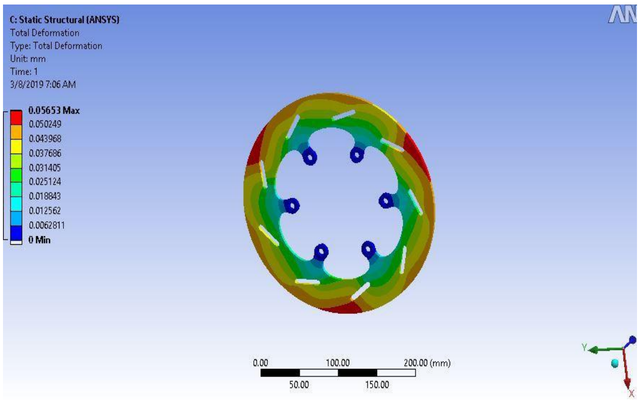

Fig 7 Al Deformation

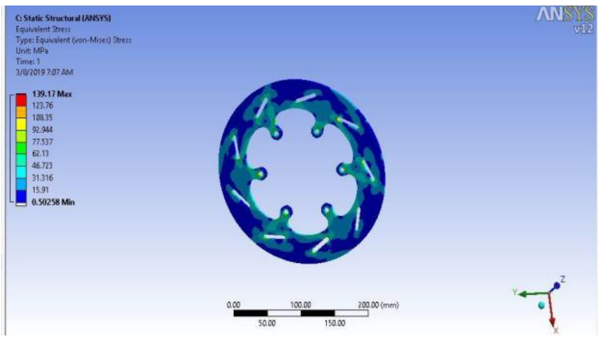

Fig 8 Al Stess

Retrieval Number: D9233118419/2019©BEIESP
DOI:10.35940/ijrte.D9233.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

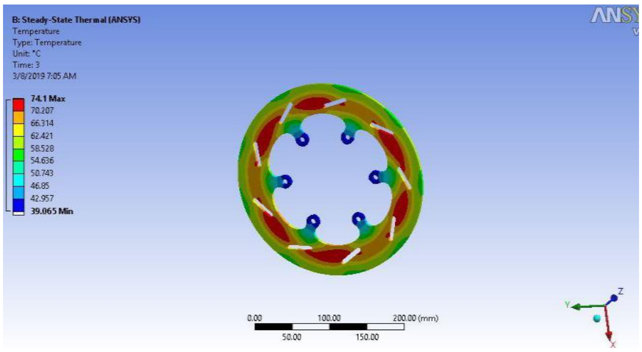

Fig 9 Al Temperature

D. *Proposed design analysis*

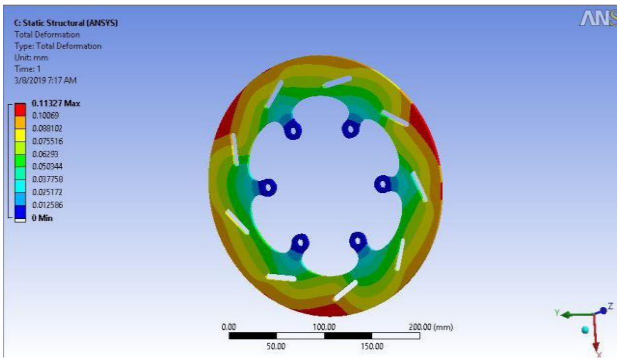

Fig 10 Deformation

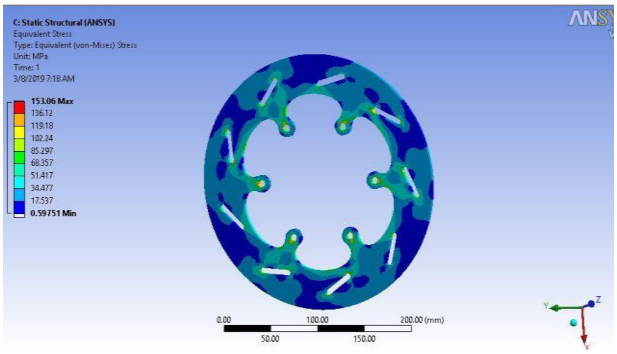

Fig 11 Stress

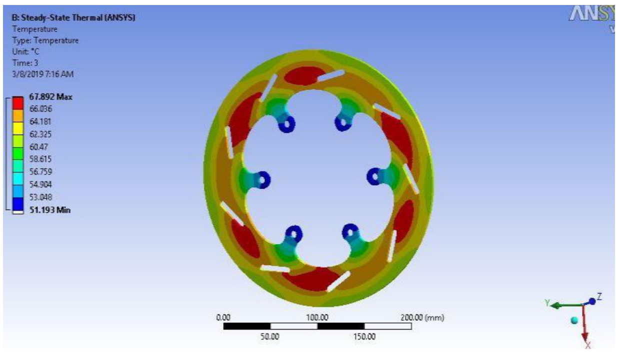

Fig 12 Temperature

Table no 1 Conventional Model Results

	Cast iron	Aluminium
Deformation	0.12909	0.22398
Stress	621.25	667.57
Temperature	87.55	86.866

Table no 2 Proposed model results

	Cast iron	Aluminium
Deformation	0.05653	0.11327
Stress	139.17	153.06
Temperature	74.1	67.892

IV. CONCLUSION

As per the investigation of configuration models of disc brakes with divergent materials, we have seen that our proposed structure is far superior to the traditional plan. Here based on thermal investigation, cast iron is the best significant material for disc brake. Anyway cast iron disc brakes experience a tangle of getting consumed while it interacts with dampness. Additionally the heat distribution from disc brake also identified.

The dissimilar design models studied are:-

i. Model No. 1- With conventional round holes.
ii. Model No. 2- With kidney shaped holes

Upon comparing all the above models finest heat dissipation is seen in proposed model made up of cast iron.

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