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Thermal analysis of brake drum

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ABSTRACT

Excessive thermal stresses can cause undesirable effects on the material of the brake drum. Which leads to the initiation of a crack. This paper gives the basic idea to analyze thermal stress and thermal expansion in a brake drum of a heavy commercial truck due to temperature distribution in severe braking conditions. The analysis is done using the finite element approach in ANSYS software by stimulating temperature distribution and the thermal stress distribution within brake drum material. The evaluation of simulation results will help in prediction and contribute toward improving the design, modeling, and analysis techniques for the integrity of the thermo-mechanical systems that subjected to high temperatures.

***Keywords**: Ansys, Static Structural, Heat Flux*

1. INTRODUCTION

Brake system plays vital role in all kinds of vehicle. In efficient performance of braking system may cause undesirable effects on the vehicle's safety reliability. However, failure in such system might cause fatality especially for large commercial vehicle. The development of more efficient brake has become significant with this kind of situations.

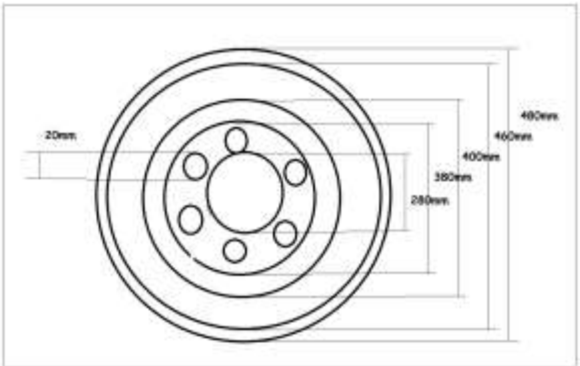
The temperature of the brake drum increases during each stop. The amount of increment will be determined by the vehicle speed and weight, the rate of stop and the mass of the brake components, especially that of drum and rotors.

The thermal stress and thermal expansion that occur in a brake drum during braking may cause undesirable effects on the material of the brake drum leads to the initiation of a crack causing trouble for a large commercial vehicle like truck. Thermal analysis and calculations are performed on two materials(Aluminium Alloy and Grey Cast iron) to analyze the heat flux created during braking.

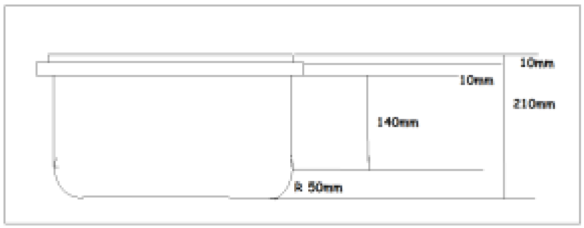
2. MODELLING OF BRAKE DRUM

2.1 Deign:

These are the dimensions of brake drum .The upper view and side view is given for modelling. Modelling is done in catia software in part design by drawing the sketch in 2D and perfoming some commands like shaft, pocket,etc.

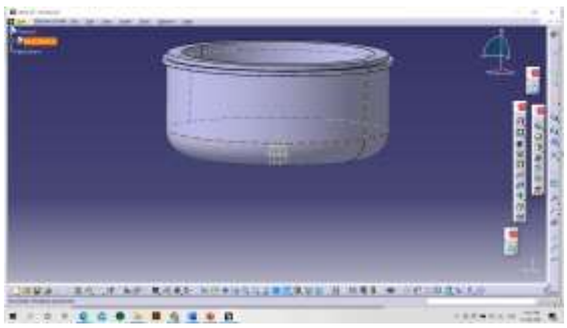


Top view

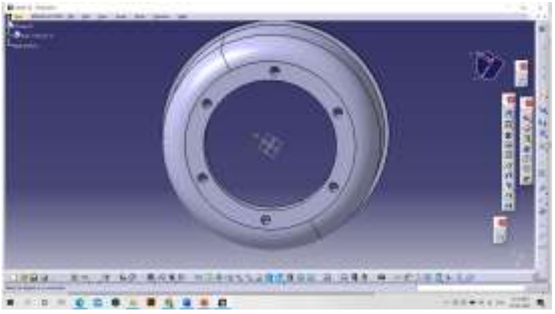


Side view

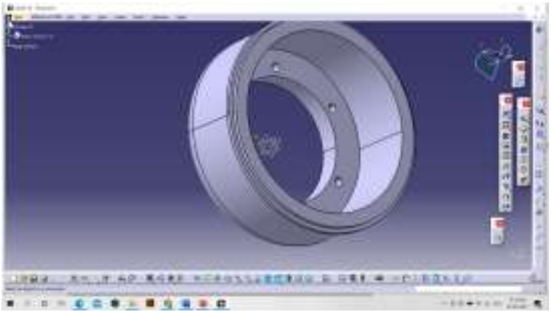
2.2Modelling in catia



1.Side View



2.Bottom View



Cad part

3.CALCULATIONS

- **Force required to stop the car:**

  m=1000kg

  v=15m/s

  s=30m

  1/2mv^2=-Fs

  ½(1000)(15)^2=-F(30)

  F=3750N

- **Frictional force acting on rubbing surface of one front brake drum:**

  Ffr=0.3F

  =0.3(3750)

  =1125 N

- **Heat energy absorbed by drum:**

  Q=0.95Ffrs

  = 30375 J

- **Heat flux generated on one break shoe:**

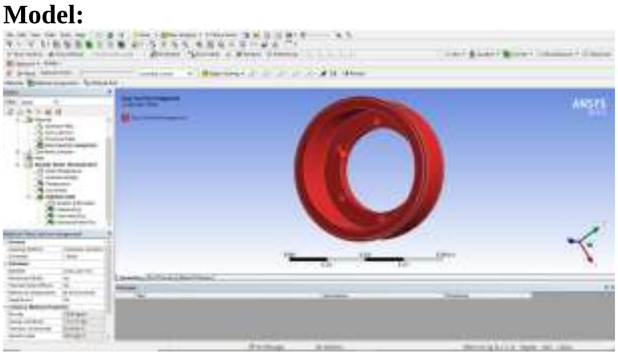
  q=1/2(delta Q/A*delta T)= W/m2

4. ANALYSIS

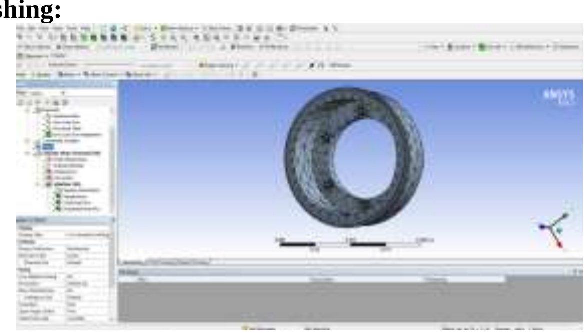
1.Grey Cast Iron:

Density (Kg/m3)	7200
Young's Modulus (MPa)	1.1e005
Poisons ratio	0.28
Thermal conductivity(w/mmC)	5.2e-002

Model:

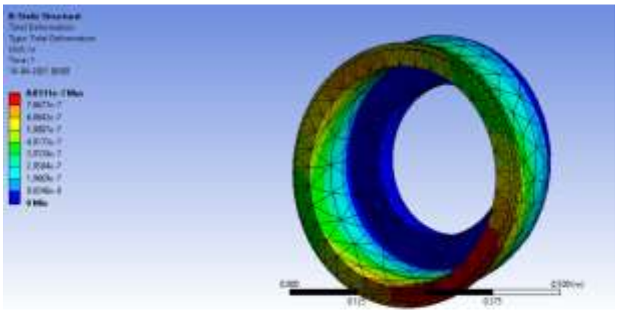


Meshing:

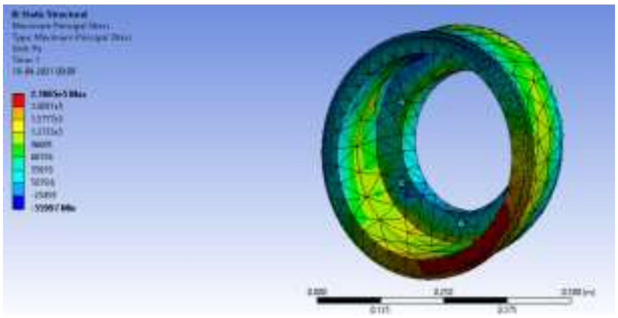


1.Static Structural:

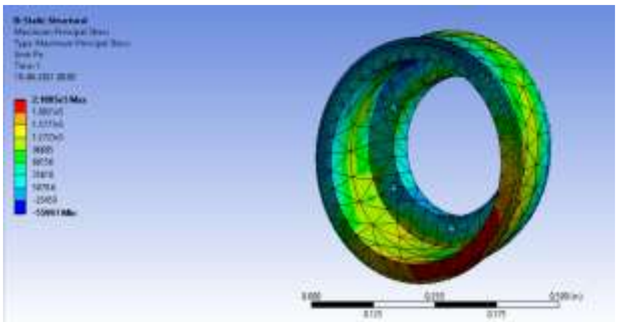
1.Total Deformation



2.Maximum Principle Stress

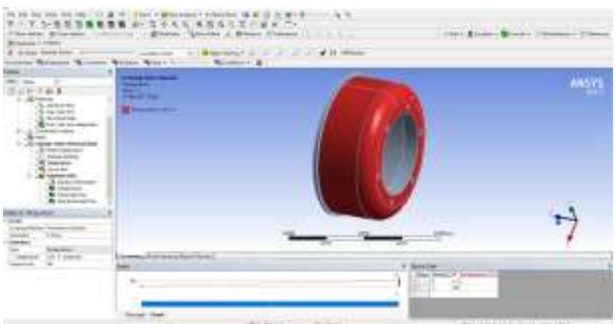


3.Maximum Principle Strain:



2.Thermal Analysis:

1.Temperature(129C)



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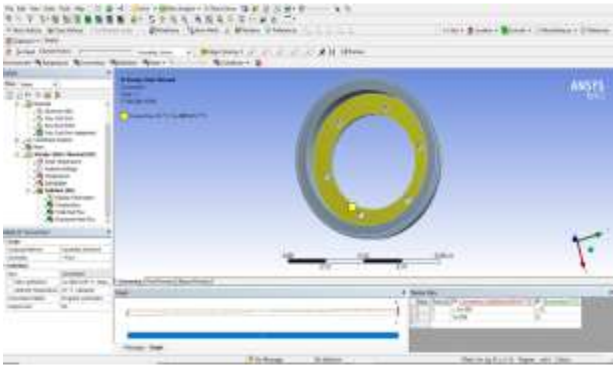
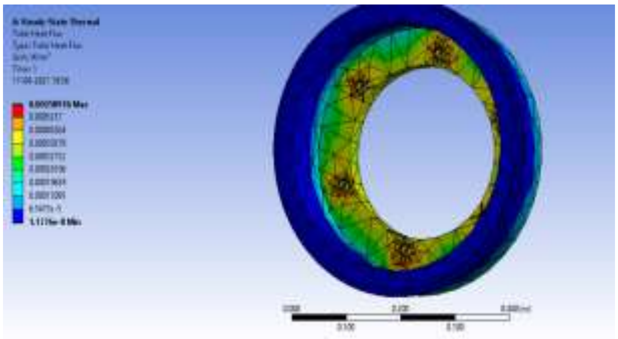
2.Convection:



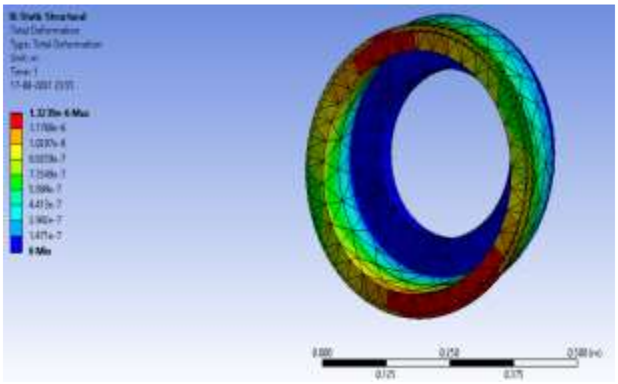
3.Total Heat Flux:



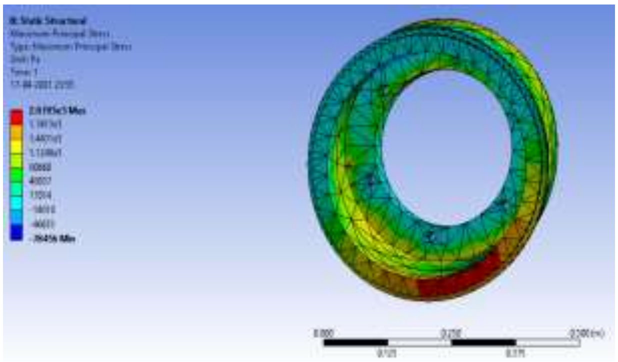
2.Aluminium Alloy:

Density (Kg/m3)	2770
Young's Modulus (M Pa)	7.1e003
Poisons ratio	0.33
Thermal conductivity (w/mmC)	0.175

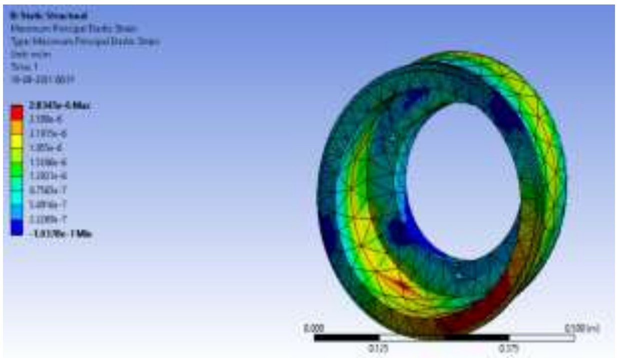
1.Total Deformation:



2.Maximum Principle Stress:

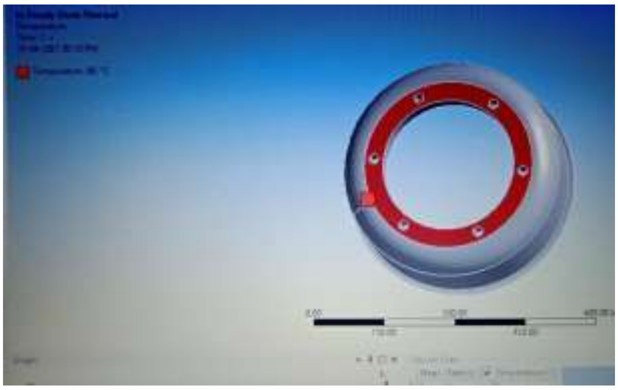


3.Maximum Principle Strain

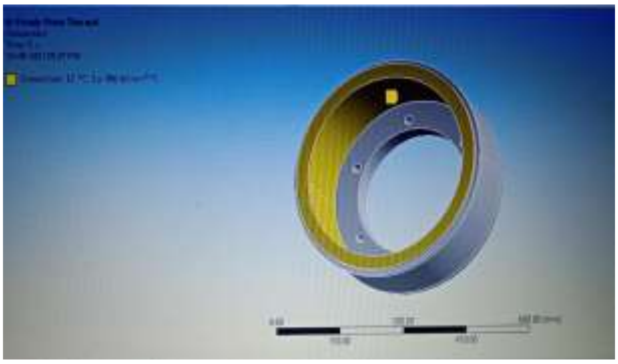


Thermal Analysis:

1.Temperature(80C)



2.Convection:



3.Total Heat Flux:

3. CONCLUSIONS

The thermal and structural analysis of two materials which are Grey cast iron and Aluminium alloy is performed on Ansys. The comparison and analysis will help in selecting the material. From the final results we found the Grey Cast Iron has less deformations and better heat flux of brake drum.

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4. ACKNOWLEDGMENT
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5. NOMENCLATURE
Ffr : Frictional Force

Q : Heat Energy

q : Heat Flux

A : Surface Area

W : Watt

T : Temperature or Celsius temperature scale

6. REFERENCES
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