PARAMETRIC MODELLING OF BRAKE DRUM AND DYNAMIC ANALYSIS FOR DIFFERENT MATERIALS

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June 4, 2018

Abstract
A brake could be a machine that inhibits motion. A drum brakes could be a brake that uses friction caused by a group of shoes or pads that press against a rotating drum-shaped half known as a cylinder. The cylinder could be an important part that experiences high temperatures and develop thermal stresses throughout application of brakes. additionally, the applying of shoe pressure offers rise to mechanical masses. Therefore, the analysis takes under consideration each the thermal stresses and mechanical stresses along. Brakes in cars and trucks square measure safety elements. necessities not solely in performance however conjointly in comfort, utility and dealing lifespan square measure high and rising. i.e. the brake pad with the friction material, the counter body and caliper, are often modelled. Therefore, during this project, we tend to style the model of drum brakes (drum, & pads) in solid works 2016 and structural and thermal analysis square measure performed in ansys work bench package.
1 INTRODUCTION

A brake is a device which is used to bring to rest or slow down a moving body. Safe operation of vehicle demands dependable brakes is required to absorb the kinetic energy of the moving parts or the potential energy of the object being lowered by host when the rate of descent is controlled. The energy absorbed by brakes is dissipated in the form of heat. This heat is dissipated in the surrounding atmosphere to stop the vehicle, so the brake system should have following requirements:

- The brakes must be strong enough to stop the vehicle with in a minimum distance in an emergency.
- The driver must have proper control over the vehicle during braking and vehicle must not skid.
- The brakes must have well anti fade characteristics i.e. their effectiveness should not decrease with is constant prolonged application.
- The brakes should have well anti wear properties.

The important requirements of the brake drum are following:

- It should provide a surface having well anti wear qualities.
- It should allow the optimum rate of heat transfer.

Heat is generated during each brake application and it must be dissipated to the atmosphere immediately, because the next brake application would again produce more heat. Any excess heating of brakes would cause the drum to expand resulting in loss of effective pedal travel and fading of brake lining.

- It should have sufficient strength but minimum weight.
- It should be able to be accommodated within the wheel space available.
2 LITERATURE SURVEY

Allan Michael Lang [1] in his research concluded that no simple relationship exists between the natural frequencies of the brake components and the squeal frequency and during squeal both the drum and shoes hold complex modes, which can be best visualized as the superposition of pairs of similar normal modes phase shifted both spatially and in time relative to each other. Mohd Zald Bin Akop [2] in his project concluded that safety aspect in automotive engineering has been considered as a number one priority in development of new vehicle and it is a must for all vehicles to have proper brake system. Ramesha.D.K et al [3] in his thesis concluded that the maximum temperature obtained for aluminum alloy brake drum is less as compared to the cast iron brake drum for a truck. Also, concluded that thermal deformation is less for aluminum alloy brake drum than the cast iron brake drum. As his study states that the weight of Aluminum is lesser than the Cast iron, it is better to use the Aluminum material in the construction of brake drum. Nurulhuda Binti Khalid [4] in his project concluded that the temperature changes on the brake drum during the deceleration providing the heat distribution and the distribution of temperature depends on the various factors such as friction, surface roughness, speed, and others. Ray W. Murphy et al [5] in their report concluded that the braking efficiency of trucks and can be improved by careful distribution of braking effort among the axles of the vehicle. Mr Songwut Mongkonlerdmanee [6] in his thesis concluded that to achieve maximum brake efficiency, vehicle geometry and real friction coefficient should be considered to design the brake proportion on each axle and the deceleration and braking distance on the front axle was better than those on the other axles because of the additional vertical load from the dynamic transfer. Muhammad najib bin abdulhamid [7] conducted the experimental analysis on drum brake and FEA analysis and concluded that improved material performs better. Kang and Cho [8] investigated thermal deformation and stress analysis of brakes by finite element method for ventilated disk and solid disk. By comparing the result of maximum temperature in the braking process, the ventilated disk showed a lower temperature than the solid disk. The effect of
temperature increase and decrease, depending on the vent area generated in the flange part of the disk. Analysis of design parameter effects on vibration modes of a motorcycle drum brake and brake shoe using the finite element method were also carried out. They reported that the drum brake had 42 mode shapes in the frequency range of 100 Hz to 12 kHz. Most of the mode shapes occurred in pair (repeated root). The brake shoe was found to have 10 modes shapes in the frequency range analysed.

3 PROBLEM STATEMENT

3.1 problem statement
Drum Brake and Drum Brake Pad are connected on the wheels of automobile for the braking of the vehicle on road. The drum brake and brake pad under goes several rough conditions on road different types of loads and temperatures will be acting on the brakes. The brakes are surely essential for the effective stopping of the vehicle. Here in this project we are taking the load condition as 1.5Mpa pressure on the face of the drum Brake and also the Drum brake pad. We are using three different materials i.e aluminium alloy, carbon steel and aluminium metal matrix composite. Doing the analysis on three different materials using the load condition we will find which is the best appropriate material for use. Also when the brake is applied due to the friction between the drum and the brake pad certain heat is distributed and released. Here we consider the thermal conditions to be as 90deg temperature and 22deg convection. Thus applying all the load and thermal conditions for three different materials Drum Brake and Brake Pad we conclude the best desirable materials.

3.2 objectives of project
(i) To develop structural modeling of Drum Brake and Brake Pad.
(ii) To perform finite element analysis of Drum Brake and Brake Pad.
(iii) Suitable material study.
(iv) Study of load and Thermal factors.
(v) Study of stress, strain deformation, temperature and heat flux induced in the Drum Brake and Brake Pad.
(vi) To develop structural optimization model of connecting rod

4 DESIGNING OF A DRUM BRAKES BY USING SOLID WORKS

4.1 Introduction to Solid works

Solid works mechanical design automation software is a feature-based, parametric solid modelling design tool which advantage of the easy to learn windows TM graphical user interface. We can create fully associate 3-D solid models with or without while utilizing automatic or user defined relations to capture design intent. Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allow them to capture design intent A Solid Works model consists of parts, assemblies, and drawings. Typically, we begin with a sketch, create a base feature, and then add more features to the model. (One can also begin with an imported surface or solid geometry). We are free to refine our design by adding, changing, or reordering features.

4.2 Design procedure of Drum Brakes

For designing the Drum Brakes, the following procedure has to be follow
5 ANALYSIS DEFINITION & STEPS

The steps needed to perform an analysis depend on the study type. To complete a study by performing the following steps:

- Create a study defining its analysis type and options.
- If needed, define parameters of your study.
- A parameter can be a model dimension, material property, force value, or any other input.
- Define material properties.
- Specify restraints and loads.
- The program automatically creates a mixed mesh when different geometries (solid, shell, structural members etc.) exist in the model.
- Define component contact and contact sets.
- Mesh the model to divide the model into many small pieces called elements. Fatigue and optimization studies use the meshes in referenced studies.
- Run the study.
- View results.

6 RESULT AND DISCUSSION

6.1 Material Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Density ($Kg/m^3$)</th>
<th>Youngs modulus (MPa)</th>
<th>Poisson ratio</th>
<th>Thermal Conductivity ($w/mm^o c$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Steel</td>
<td>7850</td>
<td>2.1e-005</td>
<td>0.30</td>
<td>5e-002</td>
</tr>
<tr>
<td>Grey Cast Iron</td>
<td>7950</td>
<td>2.1e-005</td>
<td>0.33</td>
<td>5.2e-002</td>
</tr>
</tbody>
</table>
6.2 ANALYSIS OF BRAKE DRUM

Figure 1: Maximum principal stress in brake drum using carbon steel

Figure 2: Equivalent elastic strain in brake drum using carbon steel
Table 1: List of Welding Equipment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Carbon steel</th>
<th>Grey cast iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic strain</td>
<td>0.005e-5</td>
<td>0.007e-5</td>
</tr>
<tr>
<td>Principal stress</td>
<td>6.83e8</td>
<td>8.43e8</td>
</tr>
<tr>
<td>Total Deformation</td>
<td>0.0006</td>
<td>0.0007</td>
</tr>
<tr>
<td>Von misses</td>
<td>1.139e9</td>
<td>1.424e9</td>
</tr>
</tbody>
</table>
Figure 5: Maximum principal stress in brake drum using grey cast iron

Figure 6: Equivalent elastic strain in brake drum using grey cast iron
Figure 7: Von misses stress in brake drum using grey cast iron

Figure 8: Total Deformation in brake drum using grey cast iron
7 CONCLUSION

- Modeling and analysis of drum brakes is done. Modeling of drum brake and drum brake pads are done in solid works 2016 design software.
- Thus both files are saved as igs to import into ansys workbench
- Structural and thermal analysis is carried on drum brake in ansys workbench
- First structural analysis of pressure of 1.5 Mpa is applied with two different materials such as grey cast iron, carbon steel
- Maximum stress, deformation, strain, Temperature and Heat flux are found and tabulated.
- Temperature distribution and total heat flux are obtained and tabulated.
- Thus the stress, strain, shear stress and total deformations values are obtained and tabulated.
- From result we can conclude that beside general material, grey cast iron which is economically less cost and less weight ratio gives nearly same stress and deformation value in static analysis and giving good thermal distribution value so it can also use as the material for drum brake beside general materials. Thus the modeling and analysis of drum brake is done with different materials at different boundary conditions.

References


