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RESEARCH ARTICLE OPEN ACCESS

DESIGN AND ANALYSIS OF DRUM BREAK

T.Jaya Sriram*, Chetanshil Kumar Patel , A.Balakrishna ,Ch.Jaya Krishna**

*(Assistant Professor, Mechanical, Guru Nanak Institute Of Technology, kanapur,India) **

(UG Scholars,Mechanical,Guru Nanak Institute Of Technology, Kanapur,India)

Abstract:

A drum brake system operates by generating friction between shoes or pads and a rotating drum, known as the brake drum, which converts kinetic energy into heat to decelerate the vehicle. The design prioritizes managing thermal and mechanical stresses to ensure consistent performance and safety. Key elements include optimizing heat dissipation, ensuring structural strength while minimizing weight, and incorporating anti-wear features to maintain long-term effectiveness. The system is designed to deliver robust braking force, maintain vehicle control during braking, and resist brake fade and wear over time

Keywords **—** Drum brake system, Friction, Shoes or pads, Brake, drum, Kinetic energy, Heat dissipation

I. INTRODUCTION

A brake is a mechanism designed to slow down or stop a moving vehicle by converting its kinetic energy into heat. For safe and effective vehicle operation, the brake system must meet several essential requirements. It must provide strong braking power to stop the vehicle quickly, especially in emergency situations, while ensuring the driver maintains full control and preventing skidding. The system should also exhibit anti-fade performance, meaning its effectiveness must remain stable even with prolonged or repeated use, and it must be resistant to wear over time to ensure long-term durability. Specifically, for brake drums, it is crucial that they provide a wear-resistant surface, efficiently dissipate heat to prevent overheating, and balance strength with lightness to minimize vehicle weight. Additionally, the design must fit within the available wheel space. Since excessive heat buildup can lead to brake fading and reduced performance, efficient heat dissipation is vital to maintaining consistent braking efficiency and preventing failure.

II.METHODLOGY

CATIA V5 is a comprehensive software solution that covers the entire product development process, from initial drafts and design to layout, production, and assembly. It is particularly useful in the *Mechanical Design Workbench*, which is the focus of this CAE training course. CATIA V5 is widely applicable across various industries, including aerospace, automotive, defense, industrial equipment, high-tech sectors, shipbuilding, consumer goods, life sciences, architecture, construction, and more. It competes with other dominant systems like CATIA V4, Pro/Engineer, NX (formerly Unigraphics), and SolidWorks.

Figure 1

A. Modeling of Drum Brake

The Drum Brake is designed using CATIA V5, a powerfull software widely used across industries such as automotive, aerospace,and heavy engineering. CATIA V5 is known for its capability to design complex 3D models and is commonly applied in part design and assembly design, making it an essential tool for developing intricate mechanical components like the Drum Brake

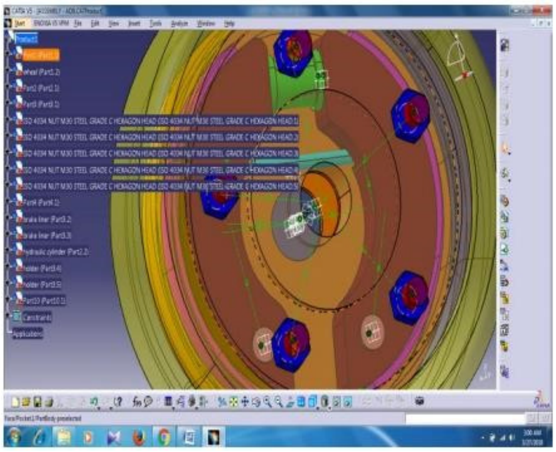

Figure 1.1

B. WORKING MECHANISM

Normal Braking: When the brakes are applied, brake fluid is forced under pressure from the master cylinder into the wheel cylinder, which pushes the brake shoes against the inner surface of the drum. The friction reduce the rotation of the drum brake, slowing down the vehicle. Once the pressure is released, return springs pull the brake shoes back to their resting position.

*Drum Brake Designs: Drum brakes are commonly categorized as **leading/trailing* or *twin leading. Rear drum brakes typically follow a **leading/trailing design* for non-servo systems or a *primary/secondary design* for duo-servo systems, with brake shoes moved by a single double-acting hydraulic cylinder. In this setup, one brake shoe always experiences the self-applying effect, which is especially useful for rear brakes. This feature helps in holding the vehicle stationary when parked, especially on inclines or when reversing. A key advantage of using a single hydraulic cylinder is the ability to incorporate a double-lobed cam at the opposite pivot, which is rotated by the parking brake system, enhancing braking force and stability.

C. Calculation

Table 1

S.No	Properties	Values
1	Young's Modulus (MPa)	2 x 10^5
2	Poison's ratio	0.3
3	Elements	Solid – 10 node 187

Table 2

S.No	Material	Aluminum
1	Young's Modulus (MPa)	7.1 x 10^5
2	Poison's ratio	0.33
3	Yield strength (N/mm2)	240
4	Mass of Component (Kgs)	10.66
5	Density (kg/m3)	2710

Table 3

S.No	Material	Carbon Steel
1	Young's Modulus (MPa)	2.1 x 10^5
2	Poison's ratio	0.30
3	Yield strength (N/mm2)	**250**
4	Mass of Component (Kgs)	**30.91**
5	Density (kg/m3)	**7860**

III.ANALYSIS OF AUTOMOBILE DRUM BRAKE

A. Procedure for FE Analysis Using ANSYS The analysis is done using ANSYS. For compete assembly is not required, motor and attached system is to carried out by applying moments at the rotation location along which axis we need to mention. Fixing location is bottom legs of assembly of the craft.

D. processor

In this stage the following steps were executed: Import file in ANSYS window:

File Menu > Import> STEP > Click ok for the popped up dialog box > Click Browse" and choose the file saved from CATIAV5R19 > Click ok to import the file

IV.RESULT

In ANSYS, after meshing the assembly components, the next step is to perform an application-based analysis to simulate real-world behavior. The meshed mode behavior.

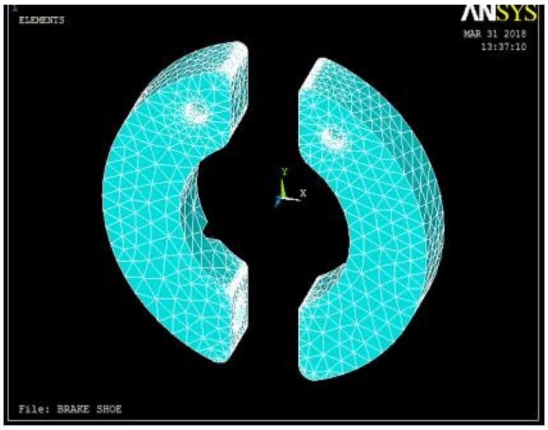

Figure 2

ls must be accurately set up in the software to ensure precise results that reflect the performance of the original components. For some components, static analysis is applied, where loads are imposed and boundary conditions (such as fixing key locations) are defined to replicate real-world constraints. It is essential to accurately input the material properties (e.g., Young's Modulus, Poisson's Ratio) and geometric details (such as dimensions) to ensure the analysis is realistic. Finally, the applied conditions must be validated against experimental or theoretical data to confirm the simulation's accuracy. By carefully defining the mesh, material and geometric

Figure 2.1

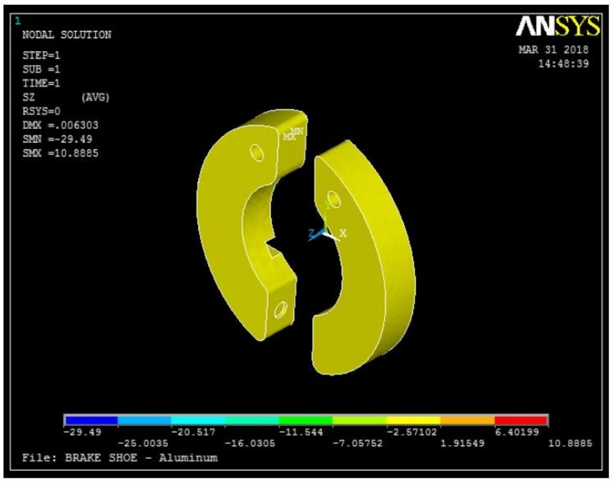

Figure 2.2

properties, boundary conditions, and loads, accurate and reliable results can be obtained from the ANSYS analysis.

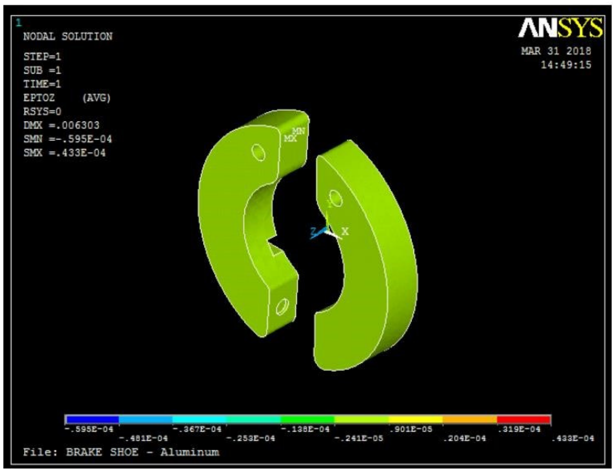

Figure 2.3

Results for BRAKE SHOE - Carbon Steel(CS) Material:

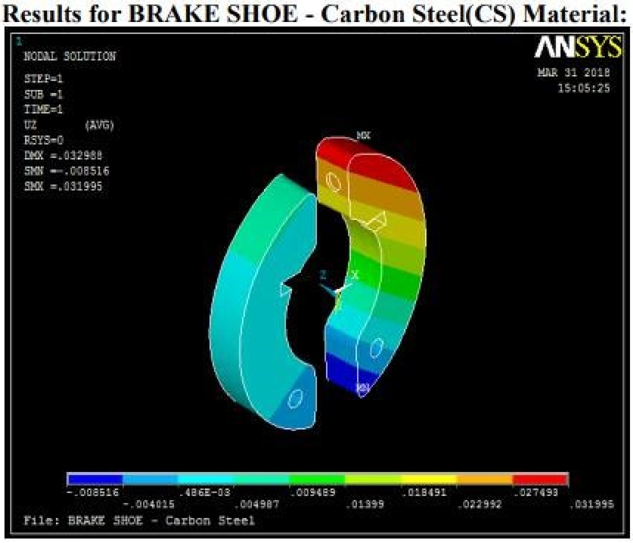

Figure 2.4

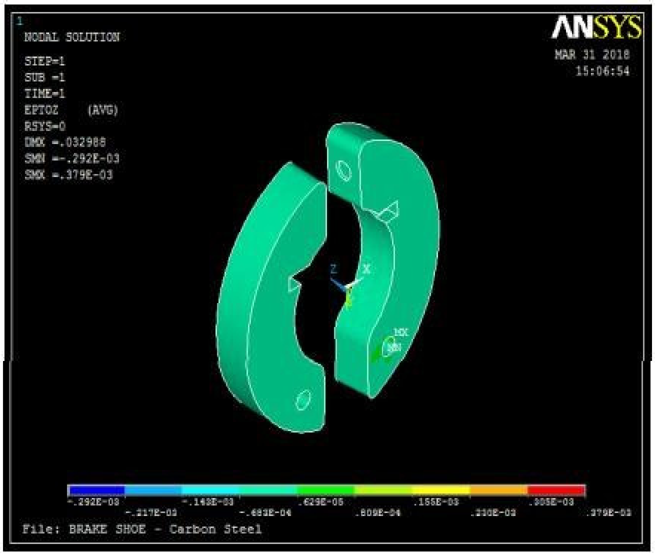

Figure 2.5

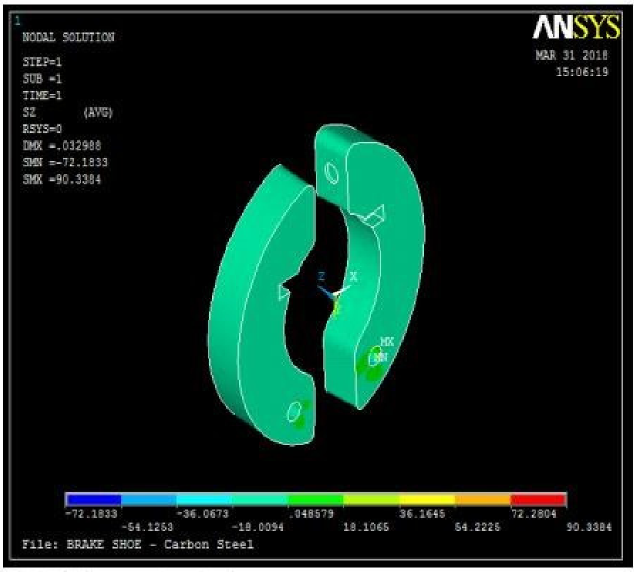

Figure 2.6

CONCLUSIONS

The results indicate that the objective of reducing the car's velocity has been successfully achieved. The displacement of the entire design assembly, as meshed and solved using ANSYS, is minimal, showing that each component experiences only minor displacement. The stress at the fixing location is within acceptable limits, being well below the yield point, and is significantly lower compared to both brake shoe models. This confirms the design's effectiveness and structural integrity Causal Productions permits the distribution and The analysis shows that the maximum stress has been effectively minimized using ANSYS software, ensuring it stays within acceptable limits. This indicates that the design parameters are largely accurate. The car drum brake design performed flawlessly in the simulation, validating the success of the design. Overall, the results confirm that the objective has been successfully achieved. revision of these templates on the condition that Causal Productions is credited in the revised template as follows: "original version of this template was provided by courtesy of Causal Productions (www.causalproductions.com)".

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