International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

# Review of Modelling and Analysis of Rotor Brakes

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**A B S T R A C T:**

This project aims to enhance automotive safety by optimizing the braking system through a novel brake rotor design. It compares a newly proposed rotor geometry with a conventional vented disc rotor commonly used in passenger vehicles. Using SOLIDWORKS, 3D models of both rotors are created and analysed through Finite Element Analysis (FEA) to evaluate structural and thermal performance. Structural analysis examines stress distribution, deformation, and load capacity under severe braking. Transient thermal analysis simulates heat generation and dissipation during braking events. Material selection focuses on properties like thermal conductivity and mechanical strength. The study compares both designs based on stress, deformation, temperature, and heat management. Results aim to improve rotor durability, reduce brake fade, and enhance overall vehicle safety.

**Keywords**: Brake Rotor Design, Finite Element Analysis (FEA), Structural Analysis, Transient Thermal Analysis, SOLIDWORKS Simulation, Automotive Safety

## 1. Introduction:

Motorcycle disc brakes have evolved significantly to enhance safety, performance, and efficiency. Unlike drum brakes, disc brakes offer better cooling, reduced brake fade, and quicker recovery from wet conditions. They work by using callipers to press brake pads against a rotating disc, converting kinetic energy into heat. Typically made from stainless steel or advanced composites, modern rotors may be drilled, slotted, or shaped to improve heat dissipation and braking consistency.

Floating rotors, which allow lateral movement, reduce warping under high temperatures. Calliper technology has also progressed from single piston to multi-piston systems for better pressure distribution and control. Disc brakes are mounted externally on motorcycles for optimal airflow and cooling. Strategic calliper placement improves handling and stability. The integration of ABS and electronic braking aids further boosts rider safety, while future developments explore lightweight materials and smart braking technologies for enhanced performance.

## 2. Literature review

- B. M. Saiful Islam focuses on using Finite Element Analysis (FEA) to simulate the structural and thermal behaviour of disc brakes under various operating conditions. His work enables precise stress and deformation predictions to enhance brake design. The modelling incorporates material properties and boundary conditions for accuracy. It aids in optimizing performance and improving safety.
- Y. Huang, research emphasizes the coupled thermal and mechanical effects in disc brake systems. His models assess how heat generation during braking impacts stress, expansion, and potential failure. The study helps predict thermal fatigue and ensures better heat management. It contributes to the design of thermally stable and durable brake components.
- M. Eriksson investigates the friction and wear behaviour between brake pads and rotors. His tribological studies examine material degradation, surface interactions, and wear mechanisms. The work supports selecting materials for enhanced lifespan and performance. It also addresses the environmental impact of brake wear particles.
- J. H. Chen develops dynamic models that simulate braking performance under different loading and speed conditions. His work includes vibration analysis and system response to improve control and stability. The models integrate mechanical and thermal parameters for realistic simulations. This helps in understanding braking dynamics and refining system design.
- S. Talati explores the mechanisms of heat generation and dissipation during braking events. His work uses analytical and numerical methods to evaluate temperature distributions. The study is crucial in minimizing brake fade and thermal damage. It supports design improvements in vented and solid disc configurations.
- J. H. Griffin investigates the causes of high-frequency noise (brake squeal) and its link to dynamic instability in brake systems. His research identifies modal coupling and friction-induced vibrations as key factors. The study uses analytical and experimental methods to propose mitigation strategies. It is valuable for enhancing user comfort and system reliability.

- N. Kinkaid, provides a comprehensive review of literature on disc brake squeal, summarizing theoretical, experimental, and computational approaches. He classifies squeal mechanisms and identifies trends in modelling and suppression techniques. The review serves as a foundation for future research and design improvements. It helps engineers understand and control brake noise effectively.

## 3. Conclusion

The simulation validates the brake rotor's design from a mechanical standpoint. The applied static loads do not result in excessive stress, displacement, or strain. The structure remains within the material’s elastic range, with safety margins below the yield strength. These results indicate that the rotor can safely withstand the expected operational loads without risk of structural failure or significant deformation, making it suitable for real-world application.

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