VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI, KARNATAKA – 590018

A Report on

Summer Internship – II carried out at

IEEE Photonics Society

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE ENGINEERING

By

Shashank Ram K 4SO21CS150

Under the guidance of

Ms Veena K Crasta

Assistant Professor
Department of Computer Science Engineering

ST JOSEPH ENGINEERING COLLEGE

(An Autonomous Institution)

MANGALURU 575028

2023-2024

	IEEE Photonics Society Bangalore Chapter	

3 Dec 2023

Internship Letter

Dear
Shashank Ram
St. Joseph Engineering College Mangaluru

I write this letter to inform you that you have done the internship under the mentors in the *IEEE photonics student's internship and mentoring program* of IEEE Photonics Society Bangalore Chapter.
Shashank Ram K a graduate of St. Joseph Engineering College Mangaluru, has worked as an intern in IEEE Photonics Society for a duration of 1 month from 20-10-2023 to 20-11-2023
Under Ms Deepa N, Dayananda Sagar University . The Title of the project work is **Study and Analysis on rail wheel using Ansys simulation tool.** During this period he worked and assisted the research work given to him with due diligence and Commitment.

1. Dr.T.Srinivas
   Advisor IEEE Photonic society
   Prof. IISC, Bangalore.
2. Dr.Preeta Sharan
   R&D Dean, TOCE, Bangalore
   IEEE Execom member Photonic society
3. Dr.C.L.Triveni
   IEEE Photonic Society Chair
   Associate Professor,
   MCE,Hassan.

Thank you.
Yours truly

1. Dr.T.Srinivas
   Advisor IEEE Photonic society
   Prof. Applied Photonics Lab, ECE Dept, IISC, Bangalore.

2. Dr.H.N.Gayathri, Professor, TOCE, Bangalore
Coordinator, IEEE Photonics internship and mentoring program,
& Students Activity Chair, IEEE Photonics Society Bangalore Chapter.

Acknowledgement:

Embarking on this internship journey with IEEE Photonics Society has been an enriching odyssey, and I extend my heartfelt gratitude to all those who made this experience possible.

My sincere gratitude also goes to R&D Dean, TOCE, Bangalore IEEE Execom member Photonic society Dr.Preeta Sharan my and Mentor at IEEE Photonics Society Ms. Deepa for their camaraderie and collaboration, contributing to a positive and engaging work atmosphere.

I extend my sincere appreciation to St. Joseph Engineering College, Vamanjoor, and specifically to Dr. Sridevi Saralaya, Head of the Department of Computer Science and Engineering. Their support and encouragement have been instrumental in shaping my educational journey. I am grateful for the academic foundation and opportunities provided by the college, which have been crucial in preparing me for the challenges and experiences encountered during this internship.

I extend my deepest thanks to my mentor Ms. Veena K Crasta, Assistant Professor in the Department of Computer Science and Engineering at St Joseph Engineering College, Vamanjoor. Her mentorship and guidance were invaluable throughout the internship, providing insights that extended beyond the technical aspects of web development.

Finally, I want to acknowledge my family and friends for their constant support and encouragement. This virtual internship has been a transformative experience, and I am genuinely grateful to everyone who played a role in making it a memorable and enriching journey.

Table of Contents:

Abstract:

This study and analysis of rail wheel utilizes the Ansys simulation tool to analyze the structural behavior of rail wheels through static structural and combined structural and thermal analysis. The research focuses on assessing load-bearing capacities, identifying stress points, and examining the influence of temperature variations on rail wheel performance. By employing detailed simulation models with real-world parameters, the study provides valuable insights into static loads, stress concentrations, and thermal effects, aiding in the optimization of rail wheel designs, materials, and maintenance strategies. The outcomes of this research contribute to enhancing the safety and efficiency of rail transportation systems.

The Ansys simulation tool facilitates a systematic exploration of various scenarios, enabling a comprehensive investigation into the structural responses of rail wheels. Through the analysis of static loads and thermal gradients, the study aims to provide practical information for engineers and practitioners in the railway industry, enabling them to make informed decisions and improvements in rail wheel design and maintenance. This research topic supports the ongoing efforts to ensure the reliability and safety of rail transportation systems by addressing critical aspects of rail wheel behavior under diverse operational conditions.

Topic: Study and analysis of rail wheel using Ansys simulation tool

Ansys Simulation Tool:

Ansys develops and markets engineering simulation software. Ansys Mechanical finite element analysis software is used to simulate computer models of structures, electronics, or machine components for analyzing the strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. Ansys is used to determine how a product will function with different specifications, without building test products or conducting crash tests. For example, Ansys software may simulate how a bridge will hold up after years of traffic, how to best process salmon in a cannery to reduce waste, or how to design a slide that uses less material without sacrificing safety.

Most Ansys simulations are performed using the Ansys Workbench system. Typically it breaks down larger structures into small components that are each modeled and tested individually. A user may start by defining the dimensions of an object, and then adding weight, pressure, temperature and other physical properties. Finally, the Ansys software simulates and analyzes movement, fatigue, fractures, fluid flow, temperature distribution, electromagnetic efficiency and other effects over time.

Figure 1: Ansys

Introduction to growing railways in India:

India's railway network is one of the largest and most complex in the world, spanning over 67,000 kilometers. It plays a vital role in the country's economy, transporting millions of passengers and tons of freight every day. However, the Indian Railways is also facing a number of challenges, congestion, and safety concerns.

Measuring the wear and tear of rail-wheel is vital for the safety and efficiency of the railway system. By understanding the rate of wear and tear, maintenance crews can schedule inspections and repairs more effectively, saving costs and downtime. Regular maintenance can also extend the life of rails and wheels, further reducing costs. Additionally, measuring wear and tear allows for early detection of defects that could lead to derailments or other accidents.

Simulation softwares like Ansys play a vital role in preventing wear and tear and ensuring the safety of rail-wheel systems. By virtually modeling and simulating the behavior of the system under various conditions, engineers can predict where and how wear and tear will occur, optimize maintenance schedules, identify design flaws, compute the temperature of rail-wheel, analyze stress and deformation, assess derailment risk and analyze dynamic behavior. This helps ensure the stability and safety of railway vehicles and reduces costs associated with wear and tear, accidents and maintenance.

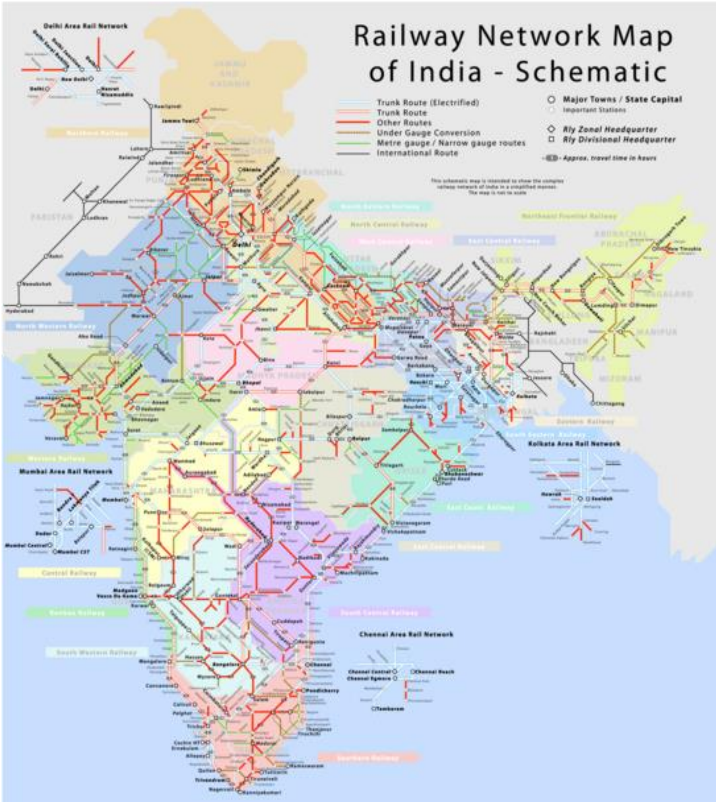

Figure 2: Railway network map of India

Benefits of Simulation Tools:

Simulation tools offer a number of benefits for the analysis of rail and wheel performance. These benefits include:

- The ability to model complex interactions between rail and wheels
- The ability to predict the behavior of rail and wheels under a variety of conditions
- The ability to identify potential problems with rail and wheel systems early in the design process
- The ability to develop preventive maintenance strategies that can help to extend the life of rail and wheels and reduce the risk of accidents

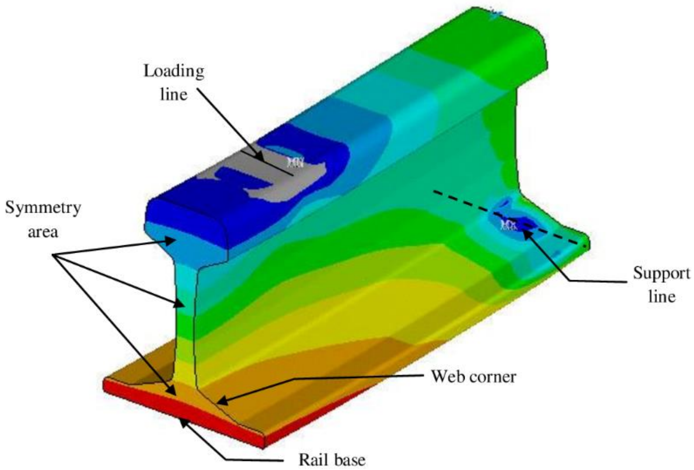

Figure 3: Analysis of a 3-D model of rail track using Ansys

Static Structural Analysis:

Why perform Static Structural Analysis:

- Load-bearing Capacity:

Static structural analysis helps determine the load-bearing capacity of the rail wheels. It assesses how well the wheels can support static loads such as the weight of the train, cargo, and passengers without experiencing excessive stresses or deformations.

- Safety Assurance:

Ensuring the safety of rail transportation is paramount. Static analysis identifies potential stress concentrations, weak points, or areas prone to failure, helping to prevent catastrophic incidents caused by structural deficiencies.

- Compliance with Standards:

Rail wheels must adhere to industry standards and regulations. Static analysis ensures that the components meet or exceed these standards for structural performance and safety.

- Material Selection and Optimization:

By subjecting rail wheels to static loads in the analysis, engineers can assess the performance of different materials and optimize the design. This process helps in selecting materials that can withstand the required loads while minimizing weight and maximizing efficiency.

- Identification of Stress Points:

Static structural analysis helps identify stress points and areas of potential failure. Engineers can then focus on reinforcing or redesigning these critical areas to enhance the overall strength and durability of the rail wheels.

- Wheel-Rail Interaction:

Rail wheels interact with the track, and static analysis allows for the examination of the contact points. This is important for understanding how the wheel distributes loads to the track and vice versa, optimizing the interaction for stability and safety.

- Performance under Stationary Conditions:

While dynamic forces are crucial during motion, static analysis provides insights into the behavior of rail wheels under stationary conditions. This is important for scenarios such as loading and unloading, where the wheels may experience significant static loads.

- Preventing Buckling or Distortion:

Under heavy static loads, rail wheels may be prone to buckling or distortion. Static structural analysis helps identify conditions that may lead to these issues, allowing for design modifications to prevent such deformations.

Boundary Conditions:

Material Used:

In the study of rail wheel behavior using Ansys simulation, the choice of material plays a pivotal role in accurately representing real-world conditions. Structural steel, renowned for its durability, strength, and widespread use in engineering applications, has been selected as the primary material for the rail wheels in this analysis. The decision to employ structural steel aligns with industry standards and ensures a realistic representation of the mechanical properties of rail wheels in railway systems.

The material properties of structural steel, such as its Young's modulus, Poisson's ratio, and yield strength, are incorporated into the simulation models as essential inputs. This inclusion enables a precise evaluation of how the rail wheels respond to static loads and thermal variations. The structural steel's well-defined mechanical characteristics contribute to the accuracy of the analysis, providing insights into stress distributions, deformations, and strain effects on the rail wheel components. By choosing structural steel as the material, the study aims to enhance the relevance and applicability of the simulation results to real-world rail wheel scenarios, thereby contributing to the optimization of rail transportation systems.

Structural Steel

Structural		
Isotropic Elasticity		
Derive from	Young's Modulus and Poisson's Ratio	
Young's Modulus	2e+11	Pa
Poisson's Ratio	0.3	
Bulk Modulus	1.6667e+11	Pa
Shear Modulus	7.6923e+10	Pa
Isotropic Secant Coefficient of Thermal Expansion	1.2e-05	1/°C
Compressive Ultimate Strength	0	Pa
Compressive Yield Strength	2.5e+08	Pa

Figure 4: Table of values for structural steel

Contacts:

In simulating the interaction between the rail and wheel components, the incorporation of realistic contact conditions is crucial for an accurate representation of the dynamic behavior in rail systems. In this analysis, a frictional contact model has been implemented to account for the interaction between the rail and wheel parts. The frictional coefficient is set to 0.3, reflecting typical values encountered in rail transport applications.

The frictional contact model considers the tangential forces generated between the rail and wheel interfaces as the train moves along the track. This approach acknowledges the presence of frictional forces that influence the wheel's motion, providing a more realistic representation of the dynamic behavior observed in operational scenarios. The chosen frictional coefficient of 0.3 is a common approximation used in rail engineering studies, offering a balance between computational efficiency and accuracy in capturing the frictional interactions.

By incorporating a frictional contact model with a specified coefficient, this simulation accounts for the complex nature of forces between the rail and wheel components. The inclusion of realistic contact conditions enhances the reliability of the analysis, ensuring that the simulation results closely align with the actual performance of rail wheels in varying operational conditions.

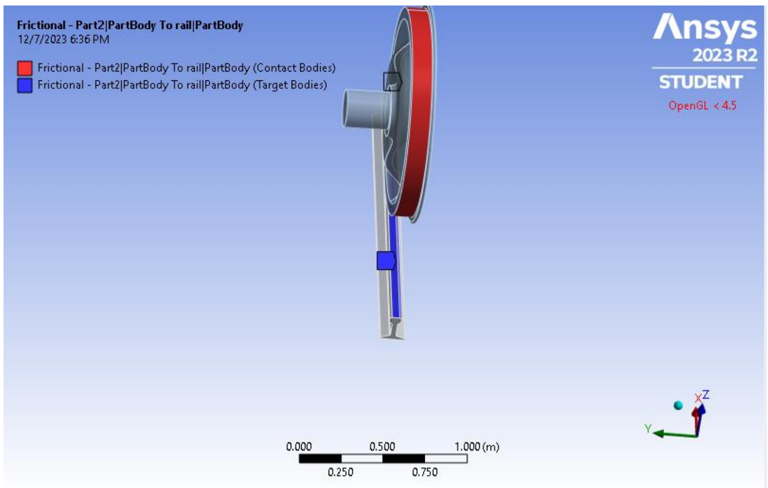

Figure 5: Frictional contact between rail and wheel

Joints:

In the Ansys simulation of rail wheel behavior, the representation of joints is a critical aspect for capturing the connections between different components and their relative motions. Three types of joints—Fixed, Translational, and Planar—have been incorporated into the simulation model to accurately emulate the mechanical constraints and interactions within the rail and wheel system.

Fixed Joints:

Fixed joints are employed to simulate immovable connections between specific parts of the rail and wheel system. These joints restrict all degrees of freedom, providing a foundation for anchoring components in place. In the context of rail wheel analysis, fixed joints may be utilized to model connections where movement is completely constrained, such as the attachment of the wheel to the axle.

Translational Joints:

Translational joints allow motion along a specified translational direction while restricting other degrees of freedom. In the rail wheel simulation, translational joints enable linear movement along a defined path, facilitating the accurate representation of translational motion between components. This type of joint is particularly relevant for capturing the horizontal movement observed in rail systems.

Planar Joints:

Planar joints simulate connections that permit motion within a specified plane while constraining motion outside that plane. In the context of rail wheel analysis, planar joints could be employed to model the interactions between components that involve complex, multidirectional movements. These joints enhance the realism of the simulation by accounting for the planar constraints observed in certain rail wheel connections.

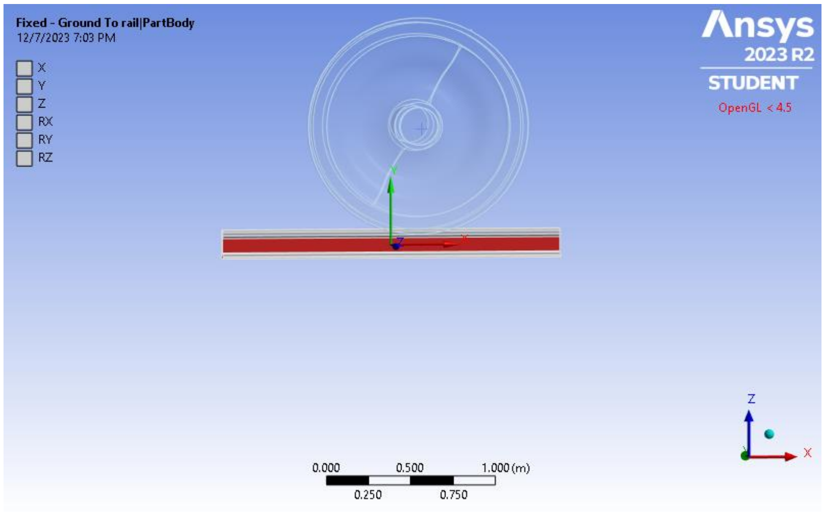

Figure 6: Fixed joint from ground to rail

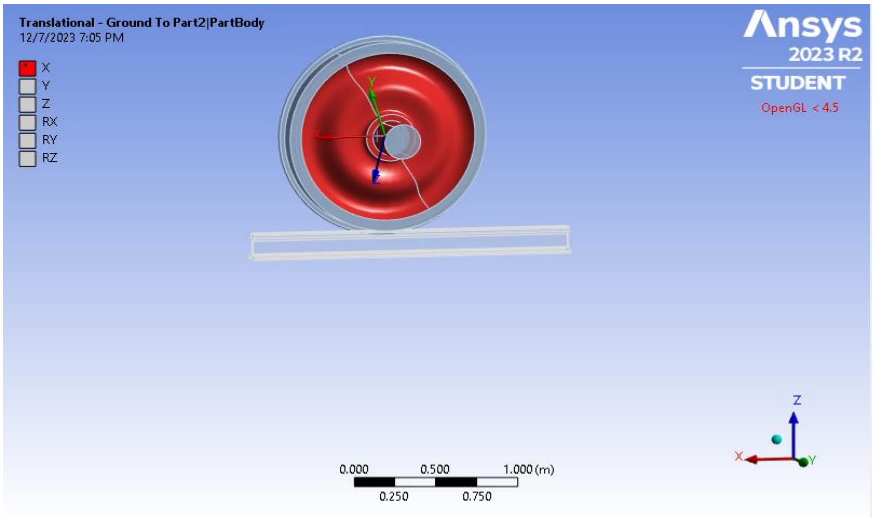

Figure 7: Translational joint

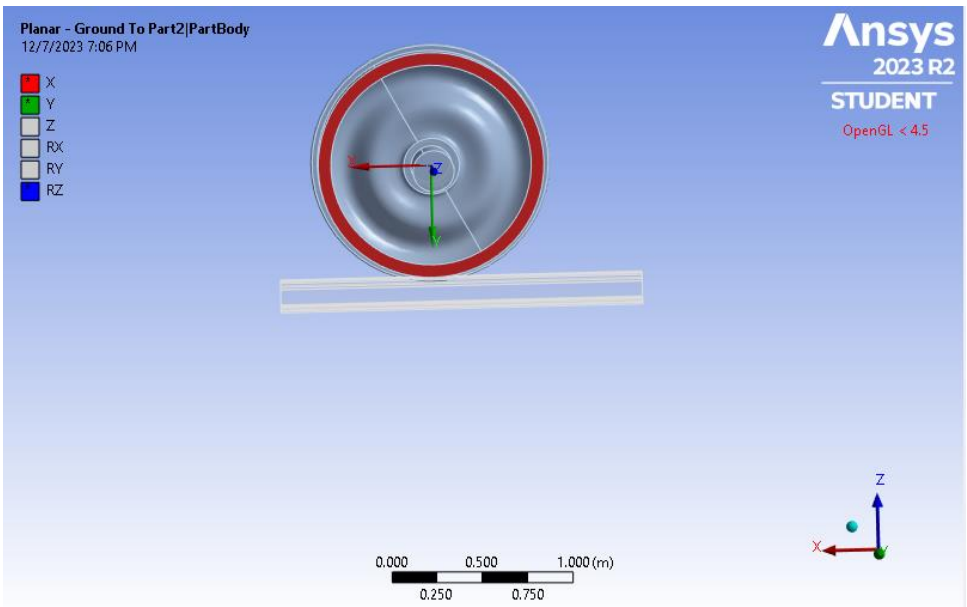

Figure 8: Planar joint

Static Structural:

Rotational Velocity (20 rad/sec):

The rotational velocity of 20 rad/sec represents the angular speed at which the rail wheel is set to rotate. This parameter is crucial in simulating the dynamic behavior of the wheel during operation.

The chosen value of 20 rad/sec is typical for certain operational conditions in rail transportation. Adjusting the rotational velocity allows for the exploration of various scenarios and their impact on the performance and stability of the rail wheel.

Displacement Joint (X-axis):

The displacement joint along the X-axis that is 0.1m in 1sec, is implemented to simulate linear movement in the horizontal direction. This type of joint allows for the realistic representation of the translational motion that the rail wheel experiences along the track. By constraining motion to the X-axis, the simulation captures the essential components of the rail system's behavior, contributing to a more accurate analysis of the wheel's response to external forces and variations in operational conditions.

Bearing Load (Assumed Value):

Bearing loads in rail wheels typically depend on factors such as the weight of the train, cargo, and passengers. Bearing load of 50 kN helps in evaluating the impact of the applied load on the wheel's structural integrity and performance. In rail engineering, the bearing load is transmitted through the wheel bearings to the axles and eventually to the rail. This load distribution is a dynamic process influenced by factors such as acceleration, deceleration, and changes in track geometry. It is essential to consider not only the static bearing load but also the dynamic loads that occur during train operation, including braking and acceleration forces.

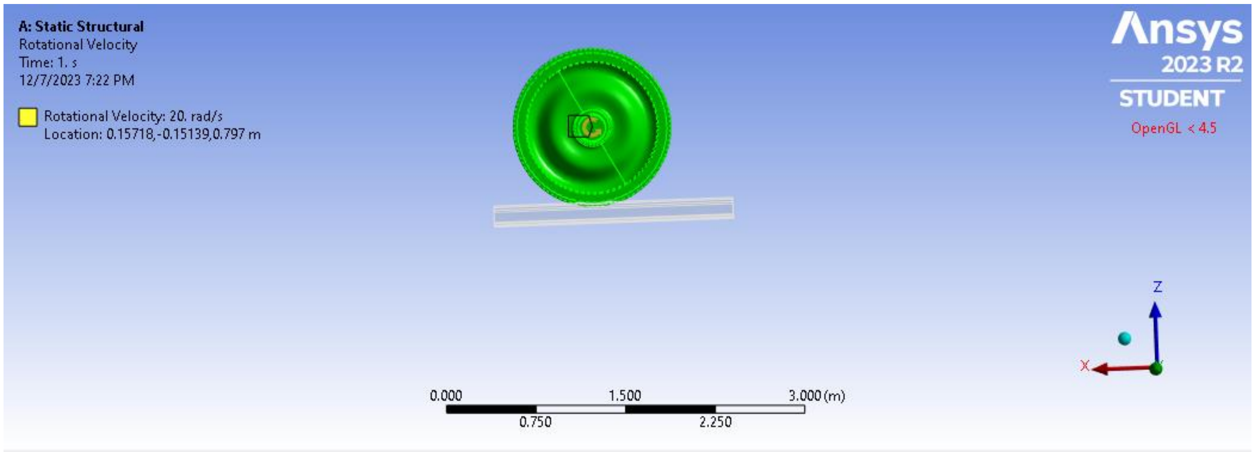

Figure 9: Rotational velocity

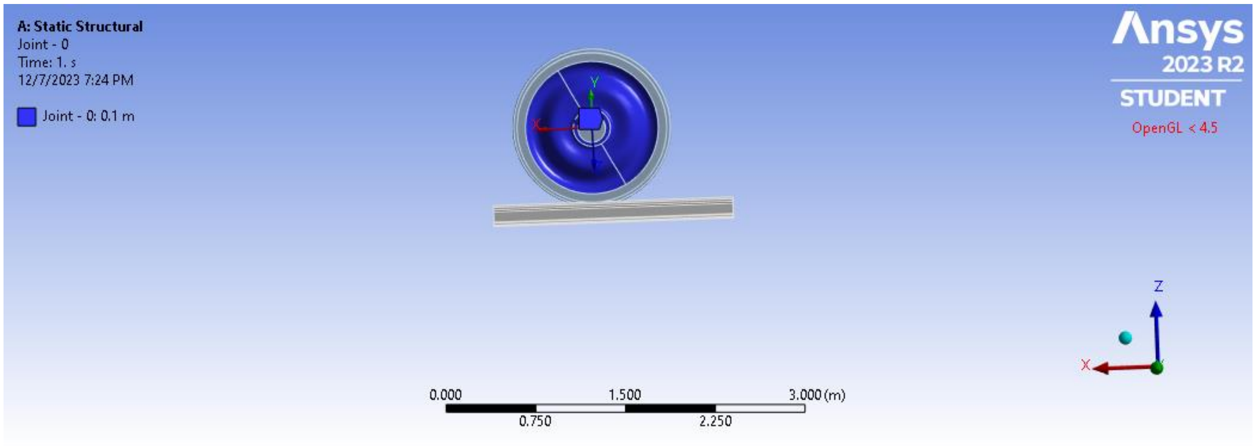

Figure 10: Displacement of 0.1m

Results:

In the solution phase of the analysis, the focus is on parameters such as equivalent stress, equivalent elastic strain, and fatigue damage is crucial for evaluating the structural performance of the rail wheel at the point of contact between the rail and wheel components. This is specific point, where maximum values of these parameters are observed, holds significance in understanding the critical conditions experienced by the rail wheel during operation.

Equivalent Stress:

Equivalent stress is a measure that combines various stress components into a single value, facilitating a simplified representation of the stress state at a given point. The maximum equivalent stress at the rail-wheel contact point signifies the highest mechanical stress experienced by the material. This information is pivotal for assessing potential yielding or failure in the rail wheel structure and aids in optimizing the design to ensure safety and longevity.

Equivalent Elastic Strain:

Equivalent elastic strain is a key indicator of the material's deformation at the point of contact. The maximum equivalent elastic strain highlights the extent of elastic deformation, providing insights into the material's ability to recover its original shape after the applied load is removed. Understanding this parameter assists in predicting material behavior, deformations, and potential areas of fatigue or failure.

Fatigue Damage:

Fatigue damage analysis evaluates the cumulative effects of cyclic loading on the rail wheel structure. The maximum fatigue damage at the contact point reflects the severity of repeated loading cycles and identifies areas prone to fatigue failure. This information is invaluable for determining the component's fatigue life, guiding maintenance schedules, and facilitating proactive measures to mitigate fatigue-related issues.

The concentration of maximum values for equivalent stress, equivalent elastic strain, and fatigue damage at the rail-wheel contact point underscores the critical nature of this region in the overall structural response. Engineers can use this information to refine designs, enhance materials, and implement targeted maintenance strategies to address potential vulnerabilities at the point of contact. By focusing on these parameters, the analysis contributes to the optimization of rail wheel performance, ensuring robustness and reliability in railway transportation systems.

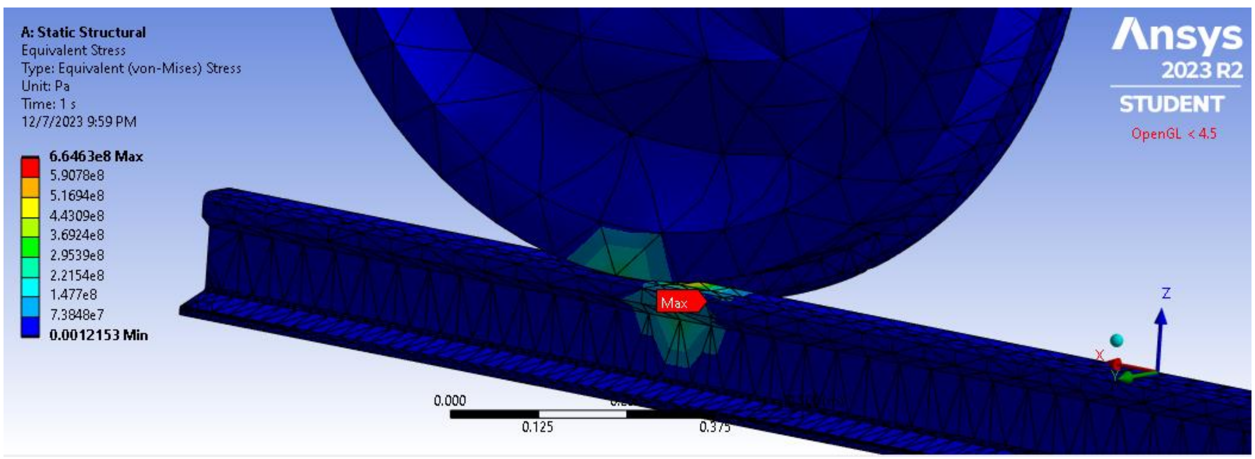

Figure 11: Equivalent (von-Mises) Stress

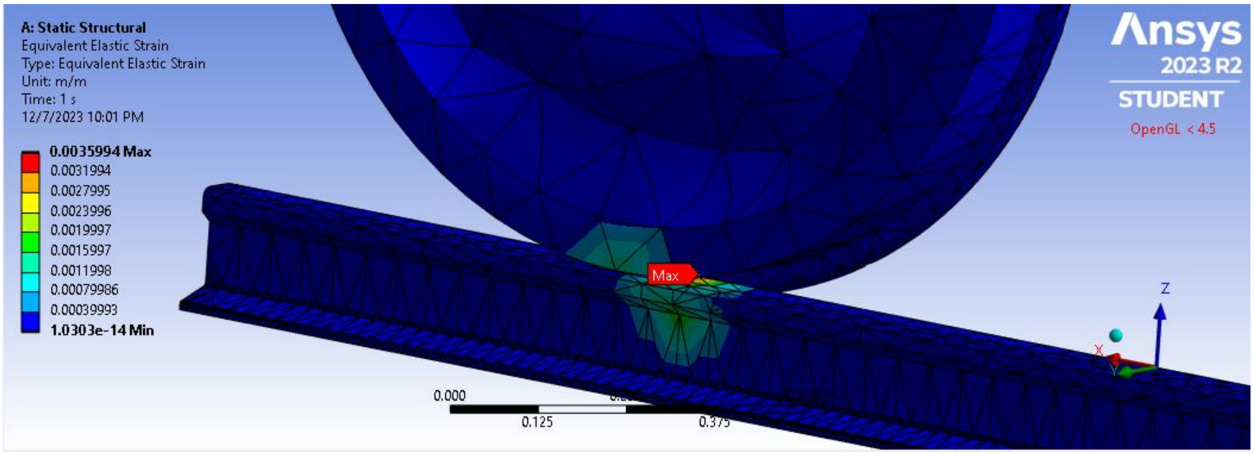

Figure 12: Equivalent Elastic strain

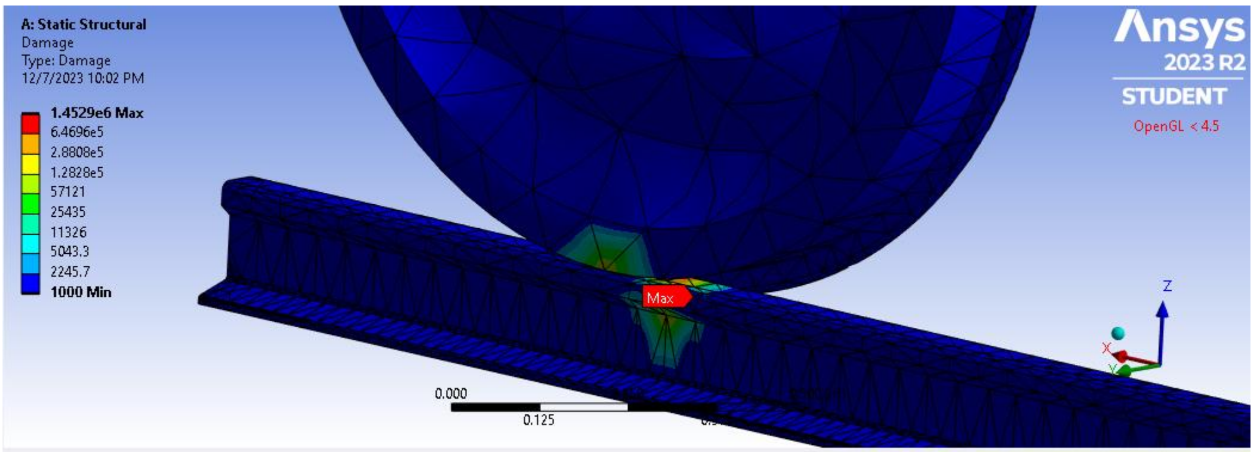

Figure 13: Damage

Inference:

The concentration of maximum values for equivalent stress, equivalent elastic strain, and fatigue damage at the rail-wheel contact point provides critical insights into the behavior and potential vulnerabilities of the rail wheel structure during operation. The inference drawn from these findings is instrumental in guiding design improvements, maintenance strategies, and overall optimization of rail wheel performance in railway transportation systems.

Critical Point Identification:

The fact that the maximum values are concentrated at the rail-wheel contact point underscores the critical nature of this region in the overall structural response. It suggests that this specific location experiences the most intense mechanical stresses, elastic deformations, and fatigue loading during the operational life of the rail wheel.

Structural Vulnerabilities:

The inference extends to the identification of potential structural vulnerabilities at the rail-wheel contact point. High equivalent stress values indicate regions where the material may be prone to yielding or failure, while elevated equivalent elastic strain values highlight areas experiencing significant deformation. The concentration of maximum fatigue damage signifies zones that are more susceptible to fatigue-related issues over time.

Design Optimization Opportunities:

Armed with the knowledge of critical points and potential vulnerabilities, engineers can optimize the rail wheel design. This may involve reinforcing specific areas, modifying material properties, or implementing design features that mitigate the impact of high stresses and strains at the contact point. Design optimization aims to enhance the structural integrity and longevity of the rail wheel.

Maintenance Strategies:

The inference about maximum fatigue damage provides valuable information for developing maintenance strategies. By understanding which areas are more prone to fatigue-related issues, maintenance schedules can be tailored to address these specific regions, prolonging the fatigue life of the rail wheel and reducing the risk of unexpected failures.

Proactive Measures for Reliability:

The inference allows for the implementation of proactive measures to address potential vulnerabilities identified at the rail-wheel contact point. By addressing these issues before they escalate, rail operators and maintenance teams can enhance the overall reliability and safety of the railway transportation system.

In conclusion, the inference drawn from the concentration of maximum values at the rail-wheel contact point serves as a foundation for targeted improvements in design, materials, and maintenance strategies. This proactive approach contributes to the optimization of rail wheel performance, ensuring a robust and reliable rail transportation system that meets safety standards and operational requirements.

Combined field transient Analysis:

A combined field transient analysis on a rail wheel involves evaluating the dynamic behavior of the wheel under various transient loading conditions, considering both structural and thermal aspects. This type of analysis is crucial for understanding how the rail wheel responds to time-varying forces and temperature changes during its operational life.

Dynamic Structural Analysis:

- Loading Conditions: Simulate dynamic loading conditions such as acceleration, braking, and vibrations experienced by the rail wheel during operation.
- Modal Analysis: Evaluate the natural frequencies and mode shapes of the rail wheel to identify potential resonances and dynamic characteristics.
- Transient Response: Study the transient response of the wheel to time-varying loads, including the prediction of deformations, stresses, and strains at different time steps.

Thermal Analysis:

- Heat Generation: Model the heat generated due to friction between the wheel and the rail, as well as any external heat sources.
- Temperature Distribution: Analyze the transient temperature distribution within the rail wheel, accounting for the effects of heat dissipation and conduction.
- Thermal Stresses: Evaluate the thermal stresses induced by temperature variations, considering the thermal expansion and contraction of materials.

Coupled Field Analysis:

- Thermo-Mechanical Coupling: Investigate the interactions between thermal and mechanical fields to understand how changes in temperature influence the mechanical response of the rail wheel.

- Heat Transfer Analysis: Analyze how heat is transferred between different components of the rail wheel, including the wheel, axle, and surrounding air.

Material Properties:

- Temperature-Dependent Properties: Consider material properties that vary with temperature, such as thermal conductivity, Young's modulus, and coefficient of thermal expansion.
- Material Fatigue: Assess the effects of cyclic loading and thermal variations on material fatigue, which is crucial for predicting the durability of the rail wheel.

Transient Loading Scenarios:

- Acceleration and Braking: Simulate the transient effects of train acceleration and braking, which result in varying forces and thermal conditions.
- Wheel-Rail Interaction: Account for dynamic forces arising from wheel-rail interactions, such as wheelset dynamics, rail irregularities, and track conditions.

Performance Evaluation:

- Fatigue Life Prediction: Estimate the fatigue life of the rail wheel components under transient loading and thermal conditions.
- Optimization Strategies: Identify opportunities for design optimization and material enhancements to improve the overall performance and longevity of the rail wheel.

A comprehensive combined field transient analysis on a rail wheel involves a detailed examination of dynamic and thermal behaviors under varying operational conditions. The study encompasses the dynamic structural response to transient loading scenarios, including acceleration, braking, and wheel-rail interactions, while concurrently evaluating thermal effects induced by friction and external temperature conditions. Considerations extend to the complex interplay between thermal and mechanical fields, coupled with the analysis of contact mechanics at the wheel-rail interface. Material properties, such as temperature-dependent characteristics and fatigue life, are crucial components. Furthermore, the study delves into cooling mechanisms, the dynamic response of adjacent components, and the rail wheel's behavior during emergency scenarios. Integration of sensors for real-time monitoring, validation through field measurements, and adherence to regulatory standards enhance the analysis. Ultimately, this holistic approach provides valuable insights into optimizing rail wheel design, improving safety, and ensuring the overall reliability of railway transportation systems in dynamic and challenging operational environments.

Figure 14: Rail wheel contact and Wheel load attenuation

Expected Results:

In a combined transient analysis of a rail wheel, the expected results for temperature will provide insights into the thermal behavior of the wheel under dynamic operating conditions. Several key findings can be anticipated:

Transient Temperature Distribution:

The analysis will yield a detailed transient temperature distribution across different components of the rail wheel. This includes the wheel rim, axle, and potentially other elements in contact with the wheel. The results will reveal how temperatures evolve over time in response to dynamic loading and environmental factors.

Temperature Peaks at Contact Points:

Expect to observe temperature peaks at critical contact points, particularly at the wheel-rail interface. These peaks may coincide with areas of concentrated friction and dynamic loading, providing crucial information about the localized thermal effects during operation.

Heat Dissipation Patterns:

The simulation will depict the heat dissipation patterns within the rail wheel. Understanding how heat is transferred and dissipated across different components is essential for evaluating the efficiency of cooling mechanisms and predicting potential overheating issues.

Transient Thermal Stresses:

Anticipate insights into transient thermal stresses induced by temperature variations. Thermal stresses are crucial factors affecting the structural integrity of the rail wheel. The analysis will identify areas prone to thermal stress concentrations during dynamic operation.

Thermal Response to Emergency Scenarios:

The analysis may reveal the rail wheel's thermal response to emergency scenarios, such as sudden braking or rapid acceleration. Identifying how temperature changes during extreme conditions is essential for assessing the robustness of the rail wheel under unexpected events.

Effect of External Temperature Conditions:

Consideration of external temperature conditions will influence the overall thermal behavior. The results will show how ambient temperature variations impact the rail wheel, helping to assess the wheel's performance in diverse environmental conditions.

Comparison of Transient and Steady-State Temperatures:

Comparisons between transient and steady-state temperatures will provide insights into the time-dependent thermal response of the rail wheel. Understanding how temperatures evolve over time is critical for predicting long-term thermal effects and potential fatigue issues.

Validation against Field Measurements:

The expected results should be validated against field measurements. This validation process enhances the accuracy of the simulation model and ensures that the predicted temperatures align with the real-world behavior of the rail wheel.

Overall, the expected results from the combined transient analysis will contribute to a comprehensive understanding of the rail wheel's thermal dynamics, guiding design optimizations and maintenance strategies to enhance the safety and reliability of railway transportation systems.

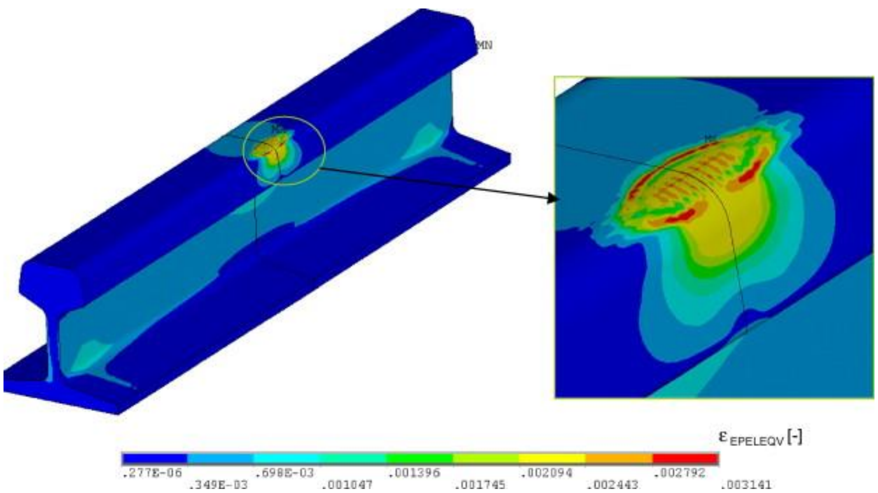

Figure 15: Rail wheel contact analysis using FEA

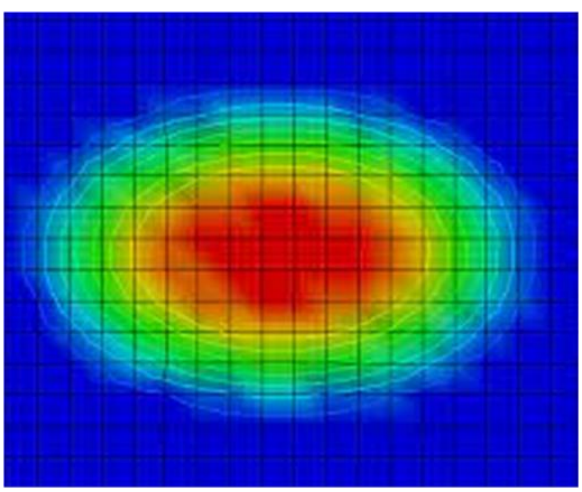

Figure 16: Maximum temperature is at the center of the contact patch between rail and wheel

Inference:

The expected results from the combined transient analysis of the rail wheel's temperature offer valuable inferences regarding its thermal behavior under dynamic operating conditions. The transient temperature distribution provides insights into the evolution of temperatures over time, highlighting critical contact points with elevated temperatures. Peaks at the wheel-rail interface signify areas of concentrated friction and dynamic loading, offering essential information for addressing localized thermal effects during operation. Analysis of heat dissipation patterns aids in evaluating the efficiency of cooling mechanisms, crucial for preventing overheating issues. Insights into transient thermal stresses guide the identification of vulnerable areas, contributing to assessments of structural integrity. Understanding the rail wheel's thermal response to emergency scenarios and external temperature conditions further refines operational predictions. Comparisons between transient and steady-state temperatures unveil the time-dependent thermal dynamics, essential for long-term predictions and fatigue assessments. Validating results against field measurements enhances the accuracy of the model, ensuring the predicted temperatures align closely with real-world conditions. Ultimately, these inferences empower engineers to optimize rail wheel designs, implement effective cooling strategies, and enhance the overall safety and reliability of railway transportation systems under diverse and dynamic operating environments.

Figure 17: Severe flat spot on rail wheel due to shelling

Overall experience and Overall reflection:

Participating in the internship with IEEE Photonics Society Bangalore Chapter for the "Study and Analysis of Rail Wheel using Ansys simulation tool" has been an immersive and transformative experience. The technical proficiency gained through static structural analysis and combined field transient analysis for contact temperature has been invaluable. It provided a deep understanding of the intricate mechanics governing rail wheel behavior under both stationary and dynamic conditions.

This experience has not only enhanced my problem-solving skills but also fostered a critical thinking approach, especially when addressing challenges related to contact temperature during the combined field transient analysis. The internship has contributed significantly to my interdisciplinary understanding, bridging various engineering disciplines to comprehend the mechanical and thermal interactions within the rail wheel system.

Effective communication and collaboration were integral aspects of the internship, involving regular discussions with team members and supervisors. These interactions improved my communication skills and conveying complex technical concepts clearly and concisely.

Beyond technical skills, the internship has played a pivotal role in shaping my career aspirations. The hands-on experience with Ansys simulation tools and the specific focus on rail wheel analysis have provided a solid foundation for pursuing a career in structural and thermal analysis, particularly within the transportation industry. Overall, this internship has been a holistic journey that has contributed not only to my academic and professional growth but also to my personal development as an engineer.

Skills Acquired and Personal development:

The internship with IEEE Photonics Society Bangalore Chapter for the "Study and Analysis of Rail Wheel using Ansys simulation tool" has been a transformative experience, contributing significantly to both my skills and personal development. Through hands-on engagement with Ansys simulation tools, I gained skills in static structural analysis and combined field transient analysis. This allowed me to create, interpret, and apply simulation models to real-world engineering challenges. The internship also sharpened my problem-solving and critical thinking skills, particularly when addressing dynamic scenarios and contact temperature challenges.

The interdisciplinary nature of the project deepened my understanding of the complex interactions between mechanical and thermal factors, offering a broader perspective on engineering challenges. Collaboration with team members and effective communication with supervisors enhanced my interpersonal and teamwork skills. The dynamic nature of the rail wheel study cultivated adaptability and learning agility, as I navigated evolving challenges. The project management aspects of the internship provided practical experience in organizing tasks, meeting deadlines, and prioritizing activities.

Beyond technical skills, the internship influenced my career aspirations, offering clarity on my professional goals within the realm of structural and thermal analysis, especially in the transportation industry. The journey was not only about skill acquisition but also personal growth. Overcoming technical challenges and successfully completing the project bolstered my confidence, instilling a sense of achievement and competence in my engineering capabilities. Overall, this internship has been a holistic and enriching experience that has shaped both my technical expertise and personal attributes.

Throughout the internship, I acquired essential skills in Ansys simulation, specifically focusing on static structural analysis and combined transient analysis. These experiences honed my ability to analyze 3D models, proficiently apply various loads, and define constraints to accurately simulate real-world conditions.

In summary, the internship equipped me with a robust skill set in Ansys simulation, particularly emphasizing static structural and combined transient analyses. These skills are now an integral part of my engineering toolkit, empowering me to assess, optimize, and communicate the structural behavior of complex systems under diverse operational condition.

Conclusion:

The internship with IEEE Photonics Society Bangalore Chapter, focused on the "Study and Analysis of Rail Wheel using Ansys simulation tool," has been a good experience. Through static structural analysis and combined field transient analysis, I navigated the intricacies of simulating and understanding the dynamic and thermal behaviors of rail wheels. This journey not only deepened my technical proficiency in Ansys simulation but also provided invaluable insights into the complexities of real-world engineering challenges.

Engaging in static structural analysis allowed me to unravel the stationary behavior of rail wheels under different loads and constraints. It laid the foundation for a comprehensive understanding of the structural integrity and stress distributions critical for operational reliability. The immersion in combined field transient analysis extended my skills to dynamic scenarios, offering a holistic perspective on the rail wheel's response to varying conditions over time.

By simulating contact temperature in the combined field transient analysis, allowed me to evaluate the thermal consequences of dynamic interactions. Overcoming contact and friction-related obstacles gave theoretical and practical knowledge and encouraged a problem-solving attitude. The experience was further enhanced by working with the team and effectively explaining the findings, highlighting the significance of interdisciplinary teamwork in engineering projects.

This internship has served as a means of advancing both personally and professionally. In addition to imparting technical knowledge, it gave me knowledge of structural and thermal analysis, especially as they relate to train transportation systems. My future engineering endeavours will surely be shaped by the skills I've acquired and obstacles I've overcome during my internship, which will provide me a strong foundation for taking on challenging projects with courage and creativity. In summary, this experience has broadened my technical knowledge and shed light on the intricate relationship between theory, simulation, and practical application in the field of rail wheel engineering.

Reference:

1. Mehmet Ali Arslan, Oğuz Kayabaşı, 3-D Rail–Wheel contact analysis using FEA, Advances in Engineering Software, Volume 45, Issue 1, 2012.

2. Y. Wei, Y. Wu, and Z. Duan, "Thermal and dynamic behaviors of wheel/rail contact system considering thermal-mechanical coupling effects," Journal of Vibroengineering, Vol. 20, No. 6, pp. 2414–2423, Sep. 2018, https://doi.org/10.21595/jve.2018.19606

3. K. Knothe, S. Liebelt, Determination of temperatures for sliding contact with applications for wheel-rail systems, Wear, Volume 189, Issues 1–2, 1995 Pages 91-99, ISSN 0043-1648, https://doi.org/10.1016/0043-1648(95)06666-7.

4. https://www.railwayage.com/freight/timeout-for-tech-wheel-rail-contact-and-wheel-load-attenuation/

5. https://skill-lync.com/student-projects/week-2-railwheel-and-track-109