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MULTIBODY DYNAMICS OF PASSENGER TRAINS: ASSESSING RUNNING SAFETY AND COMFORT ON CURVED TRACKS

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Summary: The conceptual simulation of a railway vehicle is essential for evaluating its running stability, safety, derailment prevention, passenger comfort, and dynamic behaviour during acceleration and deceleration. This study aims to assess these parameters following the EN14363 standard, ensuring compliance with railway safety and performance guidelines. The simulation model consists of a three-car train configuration, including a pilot cabin, a bar second-class cabin, and a second-class passenger cabin. Each car body is supported by two GC3D bogies, which have been selected based on their suitability for achieving 200 km/h operational speeds while maintaining stability and safety. A multi-body dynamics (MBD) simulation was conducted on curved tracks with three different radius values (300m, 500m, and 800m) to analyse how track geometry affects the vehicle's dynamic response. The simulations were performed at various speeds, incorporating track super-elevation and track irregularities based on ERRI B176 specifications. These irregularities, including high and low horizontal and vertical deviations, are essential for replicating real-world track conditions, evaluating the vehicle's response to variations in track geometry and the impact of irregular track geometry on ride quality. By analysing these conditions, the study provides a comprehensive understanding of the vehicle's behaviour under different operating scenarios. The results of the simulation provide critical insights into running safety, stability, track loading, and ride characteristics. The study identifies key thresholds where vehicle stability might be compromised due to speed, curve radius, or track irregularities, and highlights areas where modifications can improve performance. Additionally, the simulation aids in optimizing suspension configurations, wheel-rail interactions, and overall passenger comfort while ensuring compliance with safety standards. The findings also contribute to derailment prevention strategies and improved track maintenance practices to enhance safety at high speeds. This research underscores the effectiveness of multi-body dynamic simulations in predicting railway vehicle behaviour before real-world testing. Future research may focus on refining suspension damping characteristics, optimizing wheel profiles, and integrating active control strategies to further improve ride quality and stability. The insights gained from this study will assist in designing high-speed railway vehicles that meet both safety and performance standards while delivering an improved passenger experience.

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