

INTISARI

Kecelakaan akibat pecah ban pada ban pneumatik konvensional telah mendorong pengembangan ban alternatif yang tahan tusuk, seperti *non-pneumatic tire* (NPT). Namun, aspek keandalan jangka panjang NPT, khususnya terkait kegagalan kelelahan (*fatigue failure*) pada struktur jari-jarinya (*spoke*), masih belum dipahami secara memadai. Penelitian ini bertujuan untuk mengevaluasi pengaruh variasi ketebalan jari-jari dan kemiringan permukaan jalan terhadap performa kelelahan, sehingga dapat mendukung optimalisasi daya tahan NPT. Analisis elemen hingga (*finite element analysis*, FEA) dengan model non-linear dilakukan di bawah kondisi beban vertikal. Data energi regangan dari jari-jari dianalisis untuk memperkirakan umur kelelahan menggunakan metode prediksi kelelahan berbasis energi. Hasil penelitian menunjukkan bahwa peningkatan ketebalan jari-jari secara signifikan meningkatkan umur kelelahan, sedangkan peningkatan sudut kemiringan jalan mempercepat terjadinya kegagalan kelelahan akibat peningkatan konsentrasi tegangan.

Kata kunci: ketebalan jari-jari, ban non-pneumatik, analisis elemen hingga, energi regangan, umur kelelahan

ASBRACK

Frequent blowout-related accidents in conventional pneumatic tires have driven the development of puncture-resistant alternatives such as non-pneumatic tires (NPTs). However, the long-term reliability of NPTs, particularly regarding fatigue failure in their spoke structures, remains insufficiently understood. This study aims to evaluate how variations in spoke thickness and road surface inclination influence fatigue performance, thereby supporting the optimization of NPT durability. A finite element analysis (FEA) using a non-linear model was performed under vertical load conditions. Strain energy data from the spokes were analyzed to estimate fatigue life through an energy-based fatigue prediction method. The results show that increasing spoke thickness significantly improves fatigue life, while higher road inclination angles accelerate fatigue failure due to elevated stress concentrations.

Keywords: spoke thickness, non-pneumatic tire, finite element analysis, strain energy, fatigue life