

Design, Analysis and Simulation of Low Aspect Ratio Tyres (Non-Pneumatic) for Passenger Cars



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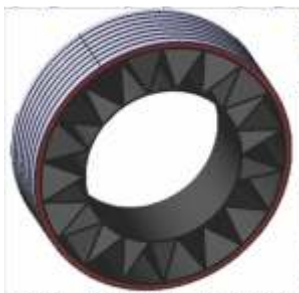
Keywords: Aspect-ratio, Non-pneumatic Tyre, Rolling Resistance, Vertical Stiffness, Handling

Abstract:

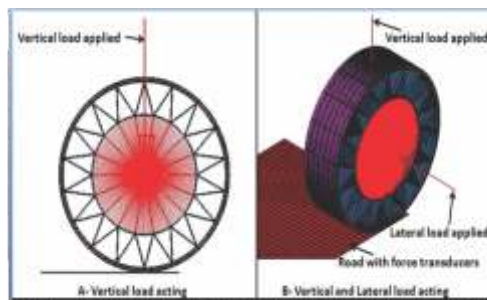
The development of pneumatic tyre technology has improved drastically over years, which have improved quality and performance of tyres. There are still some inherent disadvantages such as sudden loss in air pressure, need of regular air pressure checks, high rolling resistance and vertical stiffness. As a solution to the prevailing problems, an alternative has to be developed to replace pneumatic tyres. Work has been carried out to design a non-pneumatic tyre that has characteristics of a pneumatic tyre with better ride.

In the present work, a non-pneumatic tyre has been designed and its dynamic analysis was carried out. Study was carried out to verify whether the non-pneumatic tyre fulfils all the requirements. For this study, a passenger car was selected as benchmark. Based on its tyre dimensions geometric model of non-pneumatic tyre was created. Static analysis was carried out to obtain vertical stiffness. For dynamic analysis explicit time integration method was adopted to simulate rolling of the non-pneumatic tyre. The rolling resistance, contact patch, contact pressure, slip angle and lateral stiffness were obtained from analysis carried out. These parameters were used as inputs in MSC-Adams/Car software where the tyre properties were changed to conduct ride and handling tests.

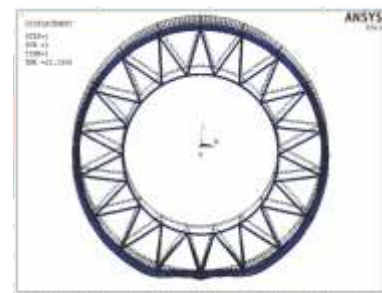
From the results obtained, it was observed that vertical stiffness and rolling resistance of non-pneumatic tyre has reduced by 28% and 18% respectively, when compared to pneumatic tyre. Uniform contact pressure distribution was observed over the contact patch. The ride performance of vehicle with non-pneumatic tyre has improved without affecting the handling characteristics.



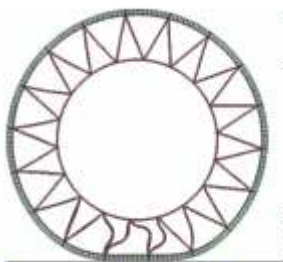
Model of non-pneumatic tyre



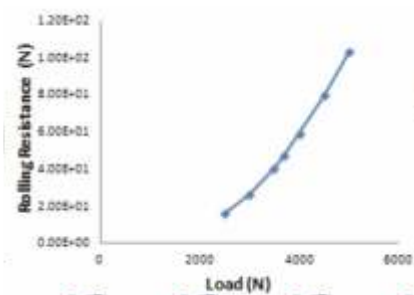
Meshed non-pneumatic tyre with loads applied



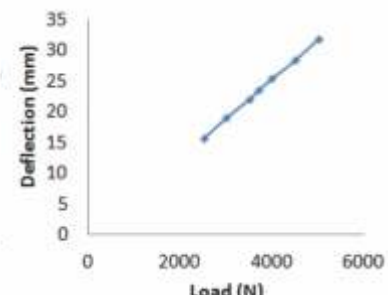
Static deflection of non-pneumatic tyre



Buckling of spokes while rolling



Load vs. rolling resistance



Load vs. static deflection