"ANSYS Fluent software helped in analyzing the hydroplaning risk of passenger car tyres by calculating the lift force on the tyres."

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ANSYS Case Study

ANSYS Fluent Software Helped in Analyzing the Hydroplaning Risk of Passenger Car Tyres

Introduction

Hydroplaning occurs when a layer of water builds up between the tyres and the road surface, which leads to loss of contact that prevents the vehicle from responding to control inputs such as steering, braking or accelerating. The tread design and dimensions play an important role in expulsion of water, thus reducing the risk of hydroplaning. Predicting the speed of onset of hydroplaning and the lift force experienced by the tyres aids in optimizing the tread pattern.

Business Challenges

Hydroplaning in tyres is a safety criterion. Hence, there is a need to minimize the loss of contact by modifying the groove design while keeping the development cost low. Experimental testing is highly expensive and limited, which affects the validation of the simulation results. Also, hydroplaning and tyre noise are conflicting phenomena and they should be optimized with proper balance.

Technology Used

ANSYS® Fluent

Engineering Solution

Computational fluid dynamics (CFD) analysis using ANSYS Fluent simulated the water flow through the car tyres. The developed simulation methodology predicted the lift force and hydroplaning speed.

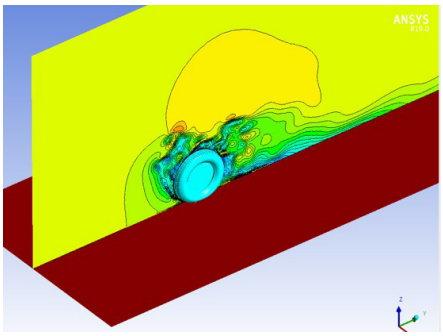
Methodology Adopted

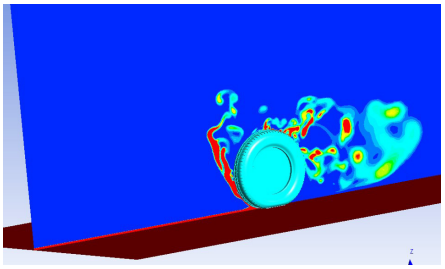
- The flow domain was modeled based on the diameter of the tyre. Both water and air were considered in the flow domain.
- The mesh was created using polyhedral cells to accurately model the tyre grooves, and the domain was separated into different zones of varying cell size.
- Two approaches were followed in methodology development: stationary tyres under load and rotating tyres without load.
- The multiphase–VOF method was adopted and the realizable k-epsilon turbulence model was used in the simulation.
- Water level was maintained at 10 mm and the inlet velocity was defined.
- Force monitors were defined to calculate the lift force on the tyre surface at the contact patch.
- The volume fraction of water and air, velocity distribution and pressure distribution were simulated.

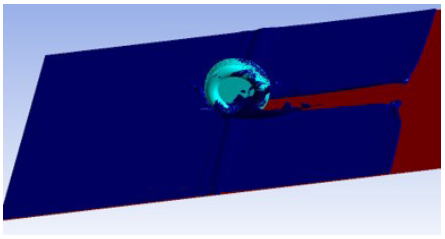
Benefits

The developed methodology helps in:

- Selecting the best tyre pattern to minimize hydroplaning.
- Optimizing water flow channel in tyres to delay the onset of hydroplaning.
- Increasing the wet grip potential of tyres.







Company Description

Apollo Tyres Ltd. Was founded in 1972 and has since been a trusted name in the business of manufacture and sales of tyres. With corporate headquarters in Gurgaon, we cater to over 100 countries across the globe. Apollo stands out at 11th position in the Global Tyre rankings and has multiple manufacturing units in India, the Netherlands and Hungary. As a brand philosophy, Apollo Tyres believes in giving its customer new choices that put them in control and help them to conquer the road ahead, as reflected in its tagline “go the distance.”

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