

Improving Mechanical Grip of Tyres on Snow and Icy Road Surfaces using Finite Element Method



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Abstract

Harsh winter conditions are known to be one of the most challenging environments for driving. Although the number of fatal accidents is higher during the summer compared to the winter in Norway (according to Norwegian Highways Authority), the total number of accidents is higher in the winter season. These accidents mainly happen due to loss traction on snowy or icy road surfaces. The loss of traction happens because there is not enough friction between the road surface and the car's tyres. To date, tyre producing companies have focused on parameters such as rubber hardness, elasticity and the adding of spikes. However, these developments have not brought about a revolutionary change in road safety.

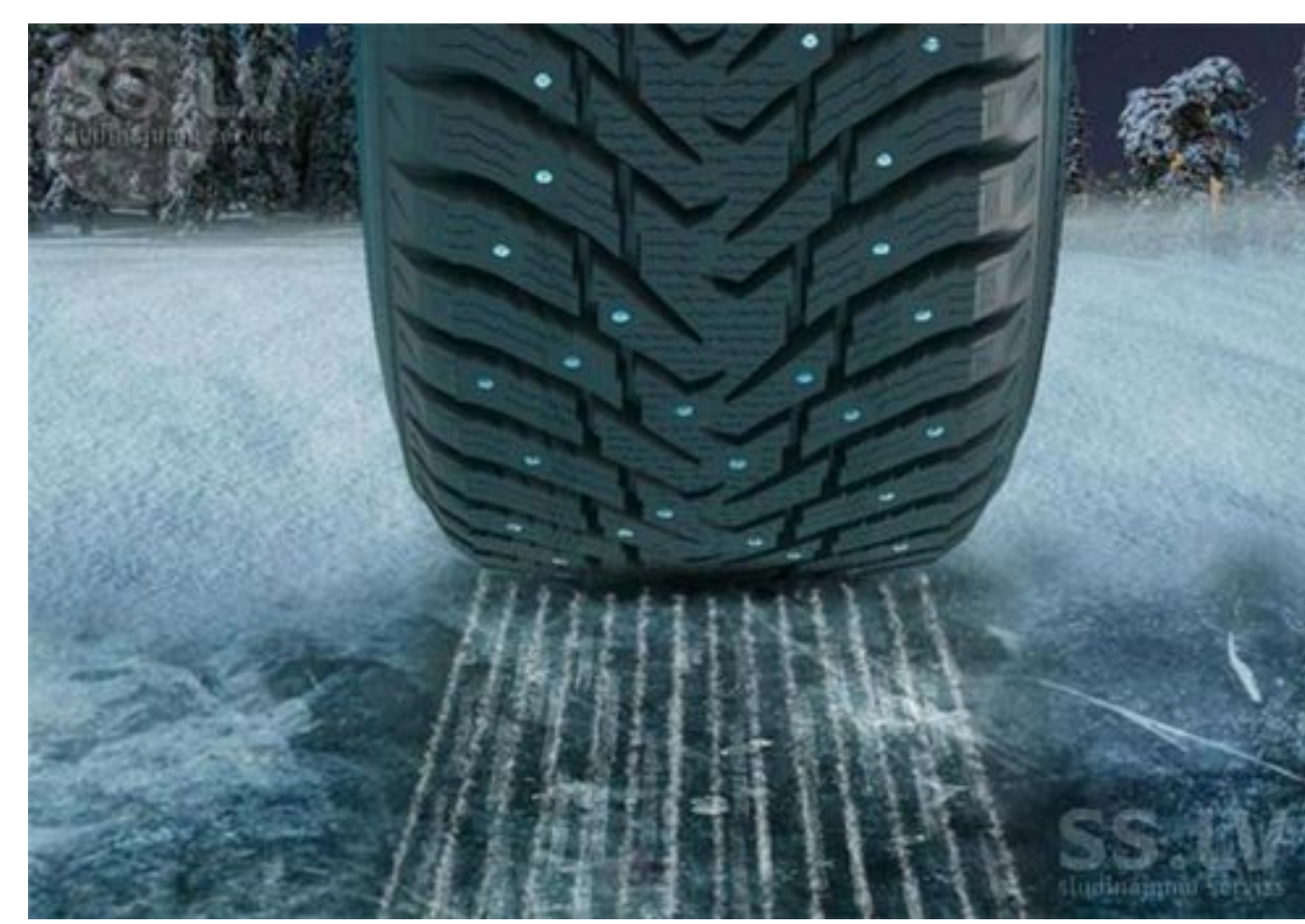
This paper presents a way to improve the mechanical grip of the tyre in snow and icy conditions by altering the profile of the contact pressure between the tyres and the surface. To modify the contact pressure profile we are proposing to replace conventional air-filled tyres with airless tyres. This will allow the designer to modify the structure inside the tyres in such a way that it will provide a concentrated contact pressure profile. By doing this we can concentrate the forces due to the weight of the car directly down to the contact point instead of distributing them throughout the tyre contact area. This concentrated contact pressure will provide a larger stick region hence providing better traction performance.

In this paper, we are proposing to conduct this design study using finite element method by ANSYS® Workbench.

Tyres traction reduces significantly under snow / icy conditions



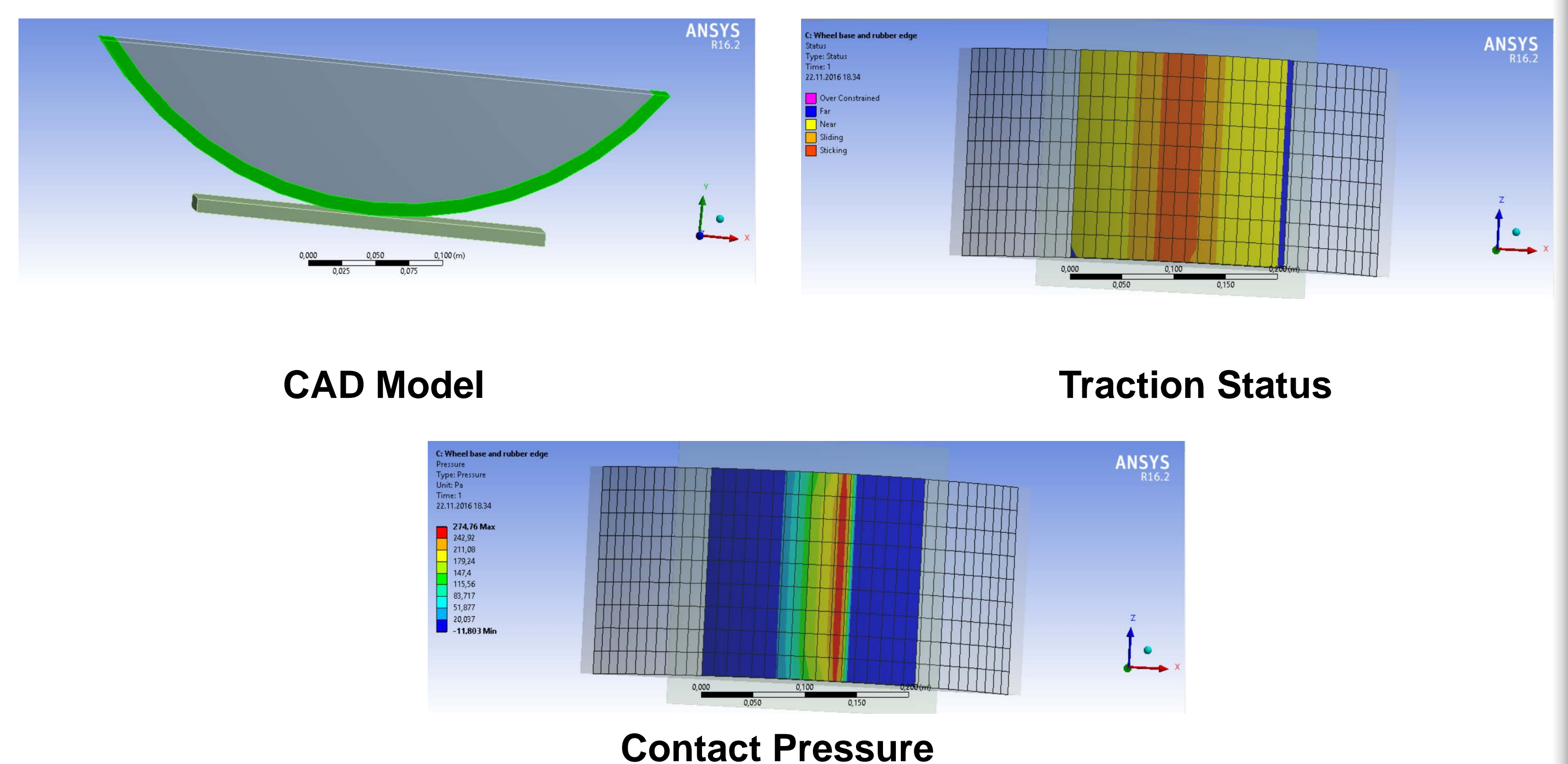
Studs or Chains are used to increase traction, however, they are damaging for the road surface



Airless tyres



Finite Element Modelling of traction profile using ANSYS® Workbench



Objectives

Design tyre that is capable of providing sufficient traction to avoid slippage in snow / ice conditions using the finite element methods.

Evaluate the feasibility of using tireless tyres for improving mechanical grip of tyres under snow / ice conditions.

Identify materials that may be used to design the airless tyres. The key requirement is that material should be able to withstand the required forces without going through the failure.

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