UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FINITE ELEMENT ANALYSIS OF TYRE USING EULERIAN APPROACH

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering (Automotive) with Honours.

By

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2011

SUPERVISORS DECLARATION

"I hereby, declare that I have read this report and in my opinion, this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Automotive)"

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Date	:	16 MAY 2011

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Date	:	16 MAY 2011

DECLARATION

I hereby, declared this report entitled "Finite Element Analysis of Tire Using Eulerian Approach" is the results of my own research except as cited in references.

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ABSTRACT

Automotive pneumatic tyre plays an important role for vehicle suspension system. Development process of tyre involved experiments which are time consuming and expensive, hence increase the tyre development cost. In order to overcome this problem, many other methods have been implemented. One of these methods is Finite Element Analysis. This aims of this project are to develop a simplified 185/70 R14 pneumatic tyre model to study road/ tyre interaction using Finite Element Method by using ABAQUS software. This project started with 2D axisymmetric tyre modeling to perform rim mounting and inflation analysis followed by 3D tyre model by revolving the 2D mesh developed. The footprint and steady state rolling analysis are performed to study the behavior of tyre when in contact with the road surface during loaded and rolling condition where this analysis is very complicated that involved high experiment cost. Instead of carry out experiment, the computational method is used to study the tyre behavior. Real tyre components are considered in this project which included one carcass, two belts and rubber matrix. In axisymmetric model, element group of CGAX3H and CGAX4H from ABAQUS are used to define the element for rubber matrix and the tyre reinforcement are represented as rebar in surface elements, SFMGAX1 are embedded into the continuum elements. After the analysis of tyre using CAE, the results are validated with result from previous research.

ABSTRAK

Tayar pneumatikOtomotif memainkan peranan yang penting dalam suspensi kenderaan. Proses pembangunan tayar melibatkan percubaan eksperimen yang memakan masa dan mahal, lalu meningkatkan kos pembangunan tayar. Untuk mengatasi masalah ini, banyak kaedah lain telah dilaksanakan dan dicuba. Salah satu daripada kaedah tersebut adalah Analisis Elemen Hingga. Tujuan projek ini adalah untuk menyediakan model tayar 185/70 R14 yang diringkaskan untuk mengkaji interaksi tayar dengan permukaan jalan dengan Kaedah Elemen Hingga menggunakan software ABAQUS. Projek ini dimula dengan membentuk model asimetrik 2D untuk melakukan mounting dan analisis inflasi dan akhirnya model 3D tayar dibentuk dengan memutarkan mesh daripada mesh model 2D. Analisis tapak permukaan tayar and analisi putaran tayar dalam keadaan mantap dilakukan untuk mempelajari perilaku permukaan jalan dengan tayar di mana tayar dalam keadaan dimuat, disi dengan angin and analisis putaran tayar atas permukaan jalan sangat rumit dan melibatkan kos eksperimen yang tinggi. Dari menggunakan kaedah eksperimen, kaedah analisi menggunakan komputer digunakan untuk mengkaji perilaku tayar. Sifat komponen tayar yang sebenar digunakan dalam projek ini. Ia termasuklah salah satu carcass, dua steel belts dan getah matriks. Dalam model axisimmetrik, elemen kumpulan CGAX3H dan CGAX4H dari ABAQUS digunakan untuk mendefinisikan unsur untuk getah matriks dan penguat tayar yang merupakan sebagai Rebar pada unsur permukaan, SFMGAX1 di mana akan tertanam ke dalam elemen kontinum. Setelah analisis ban menggunakan CAE, hasil analisis dibukti dengan percubaan eksperimen yang dimudahkan.

DEDICATION

This report is dedicate for my beloved family who never failed to give me financial and moral support, for giving all my need during the time I developed my system and for teaching me that even the largest task can be accomplished if it is done one step at a time.

I also want to send this message to my soul mate who always give moral support during hard time.

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LIST OF ABBREVIATIONS

2-D	-	Two- dimensional
3-D	-	Three-dimensional
axi	-	axisymmetric
BEM	-	Boundary element Method
CAD	-	Computer aided design
CAE	-	Computer aided engineering
CGAX3H	-	Continuum axisymmetric triangular hybrid element with twist
CGAX4H	-	Continuum axisymmetric tetrahedral hybrid element with twist
FE	-	Finite element
FEA	-	Finite element analysis
kPa	-	Kilo Pascal
SMG	-	Symmetric model generation
SRT	-	Symmetric result transfer