IMPROVEMENT OF BUS ROOF SECTION

AHMAD FARHAN HAKIM BIN AZMI

UNIVERSITY MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS ◆

JUDUL: **IMPROVEMENT OF BUS ROOF SECTION**

SESI PENGAJIAN: 2005/2009

Saya **AHMAD FARHAN HAKIM BIN AZMI (860420-06-5039)**
(HURUF BESAR)

mengaku membenarkan tesis (Sarjana Muda) ini disimpan di perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	**SULIT**	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD**	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi / badan di mana penyelidikan dijalankan)
√	**TIDAK TERHAD**	

Disahkan oleh:

_____ (TANDATANGAN PENULIS)

_____ (TANDATANGAN PENYELIA)

Alamat Tetap:

Kg. Durian Sebatang, 27400 Dong, Raub, Pahang Darul Makmur.

ZAMRI BIN MOHAMED
(Nama Penyelia)

Tarikh: **29 OCTOBER 2008**

Tarikh: **29 OCTOBER 2008**

IMPROVEMENT OF BUS ROOF SECTION

AHMAD FARHAN HAKIM BIN AZMI

Report submitted in partial fulfilment of the requirements
for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2008

STATEMENT OF AWARD FOR DEGREE

1. Bachelor Final Year Project Report

Report submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project report and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

Signature
Name of Supervisor: Mr. Zamri Bin Mohamed
Position: Lecturer / Supervisor
Date: 10 November 2008

Signature
Name of Panel: Mr. Azizuddin Bin Abd. Aziz
Position: Lecturer / Panel
Date: 10 November 2008

STUDENT'S DECLARATION

I hereby declare that the work in this report is my own except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurently submitted for award of other degree.

Signature

Name: Ahmad Farhan Hakim Bin Azmi

ID Number: MH05047

Date: 11 October 2008

TABLE OF CONTENTS

CHAPTER 3 METHODOLGY

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

σ_e	Equivalent stress
σ_y	Stress in y-axis direction
σ_{max}	Maximum stress

LIST OF ABBREVIATIONS

Al	Aluminium
ASTM	American Society for Testing and Materials
CAD	Computer-aided drafting
CAE	Computer-aided engineering
CFA	Composites fabricators association
DOF	Degree-of-freedom
ECE	Economic Commission for Europe
FEA	Finite element analysis
FEM	Finite element model
IGES	Initial graphic exchange specification
kg	Kilograms
R66	Regulation 66
RTD	Regional transportation district
TRR	Transportation Research Record
UTS	Ultimate tensile strength

ABSTRACT

Modern transit buses are an integral part of the national transportation system. According to BERNAMA, in 2007 there were about 10.8 percent increasing of people who used bus as their daily transportation in Malaysia. Although buses are one of the safest means of transportation, occupant injuries and fatalities in bus accident do occur. Rollover strength has become an important issue for bus and coach manufacturers. So, this project is basically about to investigate the bus structure used in Malaysia. As we all know, there is little amount of literature found related to bus design and safety aspect. With this project, it is hoped to increase awareness to bus safety aspect especially in bus roof section and in improving the bus roof structure. This report discusses the development of a finite element (FE) analysis for the improvement of bus roof section. The FE model was validated according to the reference journal sources and some standard guideline from European regulation "ECE-R66" were applied in this project. For that, a few current bus structures were use as benchmark and compared in this project. This bus design will then be improved around the roof section to make sure the structure can withstand more force or impact especially during accident thus can minimize the risk of bus occupants from getting severe injuries.

ABSTRAK

Kini bas transit adalah merupakan sebahagian daripada pengangkutan nasional yang terpenting. Menurut BERNAMA, dalam tahun 2007 terdapat lebih kurang 10.8 peratus peningkatan orang yang menggunakan bus sebagai pengangkutan harian mereka di Malaysia. Walaupun bas merupakan salah sebuah jenis pengankutan yang paling selamat, kecederaan penumpang dan kerosakan masih terjadi jika berlakunya kemalangan. Ketahanan gulingan telah menjadi isu penting bagi bas dan pengeluar bas. Oleh itu, secara asasnya projek ini adalah berkenaan penyiasatan atau kajian mengenai struktur bas di Malaysia. Seperti yang kita tahu, terdapat begitu sedikit jumlah rujukan mengenai rekabentuk bas dan aspek keselamatannya. Menerusi projek ini, diharapkan ianya dapat membantu mencetuskan keprihatinan mengenai aspek keselamatan bas terutamanya dibahagian seksyen bumbung bas disamping dalan meningkatkan keteguhan struktur bumbung bas. Tesis ini membincangkan perkembangan analisis 'Finite Element', (FE) untuk pengukuhan seksyen bumbung bas. Model FE ini disahkan berdasarkan kepada sumber jurnal rujukan dan garisan panduan yang ditetapkan daripada peraturan Eropah 'ECE-R66' turut diaplikasi untuk projek ini. Untuk itu, beberapa struktur bus yang digunakan pada masa kini digunakan sebagai tanda ukuran dan sebagai perbandingan dalam projek ini. Rekabentuk bus ini kemudiannya akan diperkukuhkan di bahagian seksyen bumbungya untuk memastikan struktur berkenaan boleh menahan lebih bebanan atau tekanan terutamanya semasa berlakunya kemalangan dan dengan itu dapat mengurangkan dan mengelakkan kecederaan yang serius berlaku kepada pengguna bas.

CHAPTER 1

INTRODUCTION

1.1 PROJECT INTRODUCTION

A bus comprising: a chassis supported on front and rear wheels and including a box frame for supporting construction of a body; and a body constructed from a plurality of standardized body modules on the box frame, the standardized body modules being selected from a plurality of types of standardized body modules; the types of standardized body modules including an overwheel module type with the body including a first overwheel module positioned longitudinally along the chassis over the rear wheels, and, in a non-conventional bus, including a second overwheel module positioned longitudinally along the chassis over the front wheels; and the types of standardized body module types further including multipositional standardized body module types each of which are positionable at more than one longitudinal location along the chassis, excluding over wheel locations, in one or more iterations, the types of multipositional standardized body modules including, first and second seating bay module types with the first seating bay module type having half again the longitudinal length of the second seating bay module type, an auxiliary door module type, and a side well door module type; the body including one or more modules selected from the multipositional standardized body types; and a selected one from a set of standard front end closures including a first for conventionally configured busses, a second for rear engine busses and a third for front engine busses positioned to enclose the body at its front end.

Also, bus structures are very important especially to increase the safety of the bus. For that, bus body panel joints need to be sufficiently strong to prevent them from separating during a crash and becoming cutting edges that could cause serious injuries or allow passenger ejection through openings. It is important that each large bus body panel joint be capable of holding the body panel to the member to which it is joined, when subjected to a force of 60 percent of the tensile strength of the weakest joined body panel component. These requirements apply to most joints located in the "bus body" which is the portion of the bus that encloses the occupant space, starting at the most forward point of the windshield. Excluded from these requirements are doors, windows, body panels designed for ventilation or other functional purposes, and maintenance access panels.

1.2 PROBLEM STATEMENT

This project are basically about to improved the bus safety condition at Malaysia. As we all know, there a little amount of literature was found related to the safety rule for the bus in Malaysia and according to 'BERNAMA' it just being used to Malaysia from 2004 and were followed by primary bus company. The R66 ECE are just being introduced to other bus company in 21 August 2007 after an express bus accident in Bukit Gantang on 13 August 2007 which killed 23 people *(Utusan Malaysia, 2008)* .The problem now are related to the small company that do not understand the important of this rule and were try to refuse it. Also, with the correct design of bus roof structures, deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes can be reduce.

1.3 PROJECT OBJECTIVE AND SCOPE OF STUDY

The main objective in this project is to investigate the bus structure used in Malaysia related to bus design and safety aspect that can be considered and apply. Secondly, in this project its objective also to analyze and the bus structure on a portion of the bus roof top using finite element analysis software that is Algor. For that this project consist the study of the structure suitability, redesign it and confirm the design with CAE. Then, it will be to relate that portion studies with all other portion of bus structure.

In this project, firstly the research objectives are evaluated to identify the important part that needs to be study for this project. After that, all the research study source about bus safety precaution and analysis from recent and current test were collected from journal that were get from library and internet. Then, all the suitable data and information that were collected from the journal and previous research were stated in literature review as for this project references. The methods that need to be used in this project were also developed as the guide for the workflow of this project. The focus of this work is on occupant protection in several types of buses and coaches in both the scheduled and nonscheduled transportation. For this purpose the connection between the occurrences at the real world accident scenes and the theory are compared. The simple reason for that approach was the important feedback and usable knowledge of the accident incidents and their influence to improve current test procedures. Therefore an investigation was conducted on a number of topics including statistical collision data analysis, development of a bus accident database, reconstruction of real world accidents by means of an accident reconstruction software, component testing, full scale bay section testing, development of numerical simulation models for vehicle structure and occupant behavior, parameter studies on occupant size influence, detection of injury mechanisms, cost benefit analyses for different test methods and finally the suggestion for improvements of current testing practices. Other than that, the other important part that were study in this project are about the bus roof top design analysis and how that component were combined and built to the bus body. This will be included in as one of the outcome for this project.

REFERENCES

Erich Mayrhofer,Hermann Steffan and Heinz Hoschopf. 2004. *Journal of Enhanced Coach and Bus Occupant Safety.*

F Lan, J Chen, J Lin. 2004. *Journal of Comparative Analysis For Bus Side Structures and Lightweight Optimization*.

Hsin-Li Chang and Chun-Chih Yeh. 2005. Factors affecting the safety performance of bus companies. *Journal of The Experience of Taiwan Bus Deregulation*.

Haibin Ning, Gregg M. Janowski, Uday K. Vaidya and George Husman. 2006. *Journal of Thermoplastic Sandwich Structure Design and Manufacturing For The Body Panel of Mass Transit Vehicle.*

Magnus G.H. Cruz and Alexandre Viecelli, 2006. *Journal of A Methodology of Conventional Steel By Microalloyed Steel In Bus Tubular Structures.*

J. L Gattis and Michael D. Howard. 1998. *Journal of Large School Bus Design Vehicle Dimensions.*

Pankaj S. Deshmukh. 2002. *Journal of Rollover and Roof Crush Analysis of Low- Floor Mass Transit Bus.*

Srinivas Peeta' , Pengcheng Zhang and Weimin Zhou. 2004**.** *Journal of Behavior-based Analysis of Freeway Car–Truck Interactions and Related Mitigation Strategies.*

H. L. McMaus, C. T. Dunn and M. Socha. 1998. *Journal of Design and Construction of A One-Piece Multifunctional Small Satellite Bus Structure.*

James Sharp, Eric Pesheck, David Nelson, Steve McLellan and Glen Ashdown. 2002. *Journal of Virtual Prototyping of A Transit Bus to Predict Service Life.*

Official College and The “Julio Soler” Association of Industria Engineers of Cantabria. 2003. *Analysis of The Strength To Rollover of Buses Superstructure.*