DESIGN AND DEVELOPMENT OF COMPOSITE SUSPENSION PUSH ROD FOR
FORMULA STUDENT RACE CAR

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
DESIGN AND DEVELOPMENT OF COMPOSITE SUSPENSION PUSH ROD FOR FORMULA STUDENT RACE CAR

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This technical report is submitted in accordance with the requirements of the Bachelor of Mechanical Engineering (Automotive)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

MAY 2009
CONFORMATION

I admit that have read this work and in my opinion this work was adequate from scope aspect and quality to award in purpose Degree of Bachelor of Mechanical Engineering (Automotive)

Signature: ........................................

1st Supervisor’s name: ........................................

Date: ........................................
DECLARATION

“I hereby, declare this thesis entitled Design and Development of The Composite Suspension Push Rod for Formula Student Race Car is the result of my own research except as cited in the reference”

Signature : ........................................................................................................
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Date : 12 MAY 2009
DEDICATION

To my beloved father,
Tuan Haji Abdul Rahman b. Haji Abdul Razak

And to my beloved mother,
Puan Hajjah Noor Azian bt. Haji Nasiruddin

who keep me continuously motivated with their great support and encouragement throughout my Bachelor Degree program.
ACKNOWLEDGEMENT

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Also with the greatest thanks to my beloved parents and Family who always pray and give the encouragement while pursuing my research and project. Their sacrifices are never being forgotten.

My greatest thanks also credited to Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka because give me a chance to get a lot of knowledge and helpers to complete my research project and also my study.

And last but not least, to all my fellow friends who involves direct or indirectly that always stand strong beside me in giving opinions and supports throughout our relationship, I really thankful and appreciate it. All yours are the most valuable things for the rest of my life.
ABSTRACT

The contemporary Formula Student racing car makes extensive use of advanced composite materials in its construction. The design, manufacture and performance testing of the composite suspension push-rods that typically could be used in a Formula Student racing car are described in this report. The design of the push rod is based on the current design use by Formula 1 race car and also current Formula Student race car. This push rod was fabricated by manual hand lay-up technique using glass fiber and polyester resin as the composite materials. The push-rod was manufactured using uniform lay-up of woven cross-ply technique. The component performance evaluations were conducted using three point bending and tensile test to determine the strength of push rod suspension when the maximum load is applied. Results obtained shows that the developed composite suspension push rod are able to function successfully according to the required specification for the Formula Student race car.
ABSTRAK

# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>DEDICATION</td>
<td></td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td></td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td></td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td>TABLE OF CONTENT</td>
<td></td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLE</td>
<td></td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF FIGURE</td>
<td></td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF SYMBOLS</td>
<td></td>
<td>xvi</td>
</tr>
<tr>
<td>LIST OF APPENDIX</td>
<td></td>
<td>xvii</td>
</tr>
</tbody>
</table>

## CHAPTER 1 INTRODUCTION

1.1 Introduction 1

1.2 Problem Statement 2

1.3 Objectives 2

1.4 Scope of Study 3
1.5 Expected Results | 3

**CHAPTER 2 LITERATURE REVIEW** | 4

2.1 History of Formula Student | 4

2.2 Formula Student Race Car Specification | 5

2.3 Suspension System | 6

2.3.1 History of Suspension | 6

2.3.2 Function of Suspension | 7

2.3.3 Types of Suspension | 8

2.3.3.1 MacPherson Strut Suspension System | 8

2.3.3.2 Double Wishbone Suspension System | 9

2.3.3.3 Multi Link Suspension | 10

2.4 Suspension Push Rod | 11

2.4.1 Push Rod and Pull Rod | 12

2.4.2 Push Rod Design | 12

2.4.3 Load at the Push Rod | 14

2.4.4 Composite Suspension Push Rod | 15

2.5 Composite Material | 15

2.6 Fibers for Reinforcement Plastic Composite | 16

2.6.1 Glass Fiber Reinforcement Plastic | 17

2.6.2 Carbon Fiber Reinforcement Plastic | 18

2.6.3 Comparison of Mechanical Properties Between | 20
Carbon Fiber and Glass Fiber Reinforcement Plastic

2.7 Open Mold Process for Fiber Reinforcement Plastic 22

2.7.1 Hand Lay-up Process 22

2.7.2 Spray-up Processes 24

2.7.3 Vacuum Bag Process 25

2.7.4 Resin Transfer Molding 26

CHAPTER 3 THEORY AND LOAD CALCULATION 28

3.1 Theory of Suspension Push Rod Loading 28

3.1.1 Position of Center Gravity 28

3.1.2 Calculation of Weight Transfer 31
   (Case 1 = Braking)
   Calculation of Weight Transfer 32
   (Case 2 = Cornering)

3.2 Calculation of Load at Suspension Push Rod Link 33

3.2.1 Calculation for Center Gravity 34

3.2.2 Calculation of Weight Transfer 36
   (Case 1 = Braking)
3.2.3 Calculation of Weight Transfer 36
   (Case 2 = Cornering)

3.3 Load Calculation using Quasy Static 39

3.4 Theory of Composite Calculation 42

3.4.1 Composite Calculation 44
CHAPTER 4  RESEARCH METHODOLOGY 46

4.1 Introduction 46

4.2 Process Planning 46

4.3 Explanation on Each Process Planning 49

4.3.1 Problem Statement Identification 49

4.3.2 Literature Review 49

4.3.3 Identification on Related Parameter for Composite Suspension Push Rod 50

4.3.4 Design Suspension Push Rod 50

4.3.4.1 Identify the Related Data to Design Push Rod 51

4.3.4.2 Sketches Concept Design of Push Rod 52

4.3.4.3 Design Push Rod using CAD Software (CATIA) 52

4.3.5 Load Calculation for Suspension and Push Rod 52

4.3.6 Composite Calculation for Push Rod 54

4.3.7 Fabrication of Composite Push Rod 55

4.3.8 Flexural Composite Test using Three Point Bending and Tensile Test 56

CHAPTER 5  SUSPENSION PUSH ROD CONCEPT DESIGN 57

5.1 Design Requirement 57

5.2 Concept Design 58
5.2.1 Design Iteration 1 59
5.2.2 Design Iteration 2 59
5.2.3 Design Iteration 3 60
5.3 Comparative Design Analysis 61
5.4 Final Design 62

CHAPTER 6 FABRICATION PROCESS AND FLEXURAL TEST OF COMPOSITE SUSPENSION PUSH ROD

6.1 Introduction 64
6.2 Applying Glass Fiber Reinforcement Plastic 65
6.3 First Stage of Fabrication Process 66
6.4 Second Stage of Fabrication Process 69
6.5 Third Stage of Fabrication Process 71
6.6 Flexural Test for Composite Suspension Push Rod 72
   6.6.1 Tensile Test 73
   6.6.2 Three Point Bending Test 75

CHAPTER 7 RESULTS AND ANALYSIS

7.1 Introduction 77
7.2 Tensile Test 77
7.3 Three Point Bending Test 80
# LIST OF TABLES

<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Formula SAE race car specification (<a href="http://student.sae.org/">http://student.sae.org/</a>, 2008)</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Comparative yarn properties for fiber reinforcement plastic (Smith, 2006)</td>
<td>21</td>
</tr>
<tr>
<td>5.1</td>
<td>Quality Function Deployment (QFD) design criteria</td>
<td>61</td>
</tr>
<tr>
<td>5.2</td>
<td>QFD Indicator</td>
<td>61</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>The original composite F1 chassis, McLaren MP4-1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(Savage, 2008)</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>MacPherson Strut suspension system (Longhurst, 2006)</td>
<td>9</td>
</tr>
<tr>
<td>2.2</td>
<td>Double wishbone suspension system (Longhurst, 2006)</td>
<td>10</td>
</tr>
<tr>
<td>2.3</td>
<td>Multi link suspension system (Longhurst, 2006)</td>
<td>11</td>
</tr>
<tr>
<td>2.4</td>
<td>Push rod mechanism (F1 suspension design case study, 2007)</td>
<td>11</td>
</tr>
<tr>
<td>2.5</td>
<td>Cylindrical shape of push rod suspension</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(<a href="http://zeept.wordpress.com/">http://zeept.wordpress.com/</a>, 2006)</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Elliptical shape for push rod suspension (Savage, 2008)</td>
<td>13</td>
</tr>
<tr>
<td>2.7a</td>
<td>Pinned column under axial load (Savage, 2008)</td>
<td>14</td>
</tr>
<tr>
<td>2.7b</td>
<td>Fundamental case of buckling (Savage, 2008)</td>
<td>14</td>
</tr>
<tr>
<td>2.8</td>
<td>Carbon fiber suspension push rod Honda F1 race car</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>(Savage, 2008)</td>
<td></td>
</tr>
<tr>
<td>2.9</td>
<td>Fiber glass woven roving</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(<a href="http://www.lakewoodconferences.com/">www.lakewoodconferences.com/</a>, 2007)</td>
<td></td>
</tr>
<tr>
<td>2.10</td>
<td>Process to produce glass fiber (Smith, 2006)</td>
<td>18</td>
</tr>
<tr>
<td>2.12</td>
<td>Application of carbon fiber used in motorcycle front disc guard</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>(<a href="http://parts.motorcycle-superstore.com/">http://parts.motorcycle-superstore.com/</a>, 2009)</td>
<td></td>
</tr>
<tr>
<td>2.13</td>
<td>Stress-strain behavior of various types of reinforcement fibers</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(Smith, 2006)</td>
<td></td>
</tr>
</tbody>
</table>
2.14 Hand Lay-up procedures (Akavoli, 2001) 23
2.15 Spray-up process (Akavoli, 2001) 24
2.16 Schematic of vacuum bag process (www.azom.com/, 2000) 25
2.17 General Process of bag molding (www.niir.org/, 2004) 26
2.18 Resin transfer molding process 27
   (www.jhmtechnologies.com, 2003)
3.1 Normal force on tire in static condition (Azman, 2006) 29
3.2 Vertical position at inclination plane (Azman, 2006) 30
3.3 Forces during braking (Azman, 2006) 31
3.4 Force at suspension link (Hudha, 2008) 33
3.5 Distribution force at suspension link (Hudha, 2008) 39
4.1 PSM 1 flow chart 47
4.2 PSM 2 flow chart 48
4.3 Design process flow chart 51
4.4 Load calculation flow chart 53
4.5 Composite calculation flow chart 54
4.6 Fabrication process flow chart 55
5.1 CAD model of the suspension push rod design iteration 1 59
5.2 CAD model of the suspension push rod design iteration 2 60
5.3 CAD model of the suspension push rod design iteration 3 60
5.4 Final design of suspension push rod 62
5.5 Assembly drawing of suspension push rod with universal joint 63
5.6 Dimension of the suspension push rod 63
6.1 Mold release wax 65
6.2 Weighted the weight of polyester resin and hardener 66
6.3 Set up the resin 66
6.4 Add hardener to the resin about 90:10 weight ratio 67
6.5 Applying the mold release wax on the surface of the mold 67
6.6 Applying one ply of woven glass fiber 68
6.7 Applying the resin on the surface of woven glass fiber 68
6.8 Applying chopped strand mat and resin on it 69
6.9 Rolled the layer using roller to remove the entrapped air
6.10 Put the universal join on the glass fiber
6.11 Continue applying the woven glass fiber and the chopped strand mat on the top of universal joint
6.12 Curing process in room temperature
6.13 Mark the cutting area at the product
6.14 Trimming process using hand grinder to get the desired shape
6.15 Final product
6.16 INSTRON universal test machine
6.17 Tensile test for composite suspension push rod
6.18 The suspension push rod failed laterally
6.19 The support span is set
6.20 The specimen is placed on the support span
6.21 Cracking area when the specimen start to buckle
7.1 Graph of tensile test for specimen 1
7.2 Graph of tensile test for specimen 2
7.3 Graph of tensile test for specimen 3
7.4 The push rod suspension typically failed laterally
7.5 Graph of three point bending test for specimen 1
7.6 Graph of three point bending test for specimen 2
7.7 Graph of three point bending test for specimen 3
7.8 The cracking area of the specimen
8.1 Fabrication process
8.2 The surface of the thread was grind to flat the surface
8.3 Sliding occurred at the clamp holder
8.4 Failure area of the glass fiber suspension push rod
8.5 Tensile specimens for GFRP and CFRP fail at gage area
   (Wonderly, 2005)
8.6 Weighing the composite suspension push rod
### LIST OF SYMBOLS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{\text{tire}}$</td>
<td>Force act at front tire</td>
</tr>
<tr>
<td>$K_{Tf}$</td>
<td>Front Roll Stiffness</td>
</tr>
<tr>
<td>$\Phi$</td>
<td>Roll angle</td>
</tr>
<tr>
<td>$F_{\text{FZM}}$</td>
<td>Weight transfer due to roll moment</td>
</tr>
<tr>
<td>$F_{\text{FZL}}$</td>
<td>Weight transfer due to lateral force</td>
</tr>
<tr>
<td>$v$</td>
<td>Vehicle speed</td>
</tr>
<tr>
<td>$W_f$</td>
<td>Force at front</td>
</tr>
<tr>
<td>$W_r$</td>
<td>Force at rear</td>
</tr>
<tr>
<td>$r$</td>
<td>Radius of cornering speed</td>
</tr>
<tr>
<td>$A_{ij}$</td>
<td>Extensional stiffness matrix $[A]$</td>
</tr>
<tr>
<td>$h$</td>
<td>Laminates of composite</td>
</tr>
<tr>
<td>$k$</td>
<td>Number of ply</td>
</tr>
<tr>
<td>$[Q]$</td>
<td>Stiffness matrix</td>
</tr>
<tr>
<td>$[T]$</td>
<td>Transformation matrix</td>
</tr>
<tr>
<td>$[R]$</td>
<td>Matrix transform of engineering shear strain</td>
</tr>
<tr>
<td>$I_x$</td>
<td>Moment of inertia</td>
</tr>
<tr>
<td>$r_x$</td>
<td>Radius of gyration</td>
</tr>
<tr>
<td>$\sigma_{\text{critical}}$</td>
<td>Critical stress</td>
</tr>
</tbody>
</table>
# LIST OF APPENDIX

<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>PSM 1 Gantt Chart</td>
<td>94</td>
</tr>
<tr>
<td>B</td>
<td>PSM 2 Gantt Chart</td>
<td>95</td>
</tr>
<tr>
<td>C</td>
<td>Design Iteration 1</td>
<td>96</td>
</tr>
<tr>
<td>D</td>
<td>Design Iteration 1 Technical Drawing</td>
<td>97</td>
</tr>
<tr>
<td>E</td>
<td>Design Iteration 2</td>
<td>98</td>
</tr>
<tr>
<td>F</td>
<td>Design Iteration 2 Technical Drawing</td>
<td>99</td>
</tr>
<tr>
<td>G</td>
<td>Final Design for Suspension Push Rod</td>
<td>100</td>
</tr>
<tr>
<td>H</td>
<td>Final Design Technical Drawing</td>
<td>101</td>
</tr>
<tr>
<td>I</td>
<td>Value for Cornering Speed Radius</td>
<td>102</td>
</tr>
<tr>
<td>J</td>
<td>Universal Joint Standard Drawing</td>
<td>103</td>
</tr>
<tr>
<td>K</td>
<td>Data Sheet for GFRP Chopped Strand Mat</td>
<td>104</td>
</tr>
<tr>
<td>L</td>
<td>Data Sheet for GFRP Woven Roving</td>
<td>105</td>
</tr>
<tr>
<td>M</td>
<td>Data Sheet for Resin</td>
<td>106</td>
</tr>
<tr>
<td>N</td>
<td>Tensile Test Results for Glass Fiber Suspension Push Rod</td>
<td>108</td>
</tr>
<tr>
<td>O</td>
<td>Three Point Bending Results for Glass Fiber Suspension Push Rod</td>
<td>113</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

Formula Student is the event that challenges university students to design, build, develop and compete as a one team and come out with a small single seat racing car. The purpose of this tournament is to give the experiences to the students about the real life as an engineer. They will face the real engineering life start from design until manufacture the racing car.

Nowadays, the formula student race car has makes a lot of improvement especially in term of weight from the heavyweight body chassis and components to lightweight components. This is because the minimum body car weight can gives higher performances for the car especially in handling performances. Before this, the components such as suspension system use metal. Now, many race car components use composite material such as carbon fiber and fiber glass to reduce the weight.

The suspension system material also has made some improvement from using material like steel to composite material such as fiber glass. Many of team in formula one such as Ferrari team using composite as a material at suspension system. The most important reason using composite material at the suspension system is the handling performances. Reducing the weight of the components can give a higher performance to car (Savage, 2008).
1.2 Problem Statement

In order to make some improvement in performances of car especially in term of reducing weight, sufficient understanding about the composites material especially in fiber glass composite and also understanding about the function of push rod suspension is a subject matter to complete this project. Thus, analysis using Finite Element Analysis (FEA) software is required to analyze the force for tension and compression at the push rod suspension.

1.3 Objectives

An objective of this project is to produce a composite push rod suspension for a Formula Students race car.
1.4 Scope of Study

The scopes of this project are:

a) To design the push rod suspension using CAD software, CATIA.

b) Fabricate sample of composite push rod suspension using glass-fiber reinforced polymer composite.

c) Test the sample using 3-point bending and tensile test.

1.5 Expected Result

In order to reduce the weight for the current steel push rod suspension, the final result is to produce the lightweight glass-fiber reinforced polymer composite push rod suspension for UTeM’s Formula Student race car.
LITERATURE REVIEW

2.1 History of Formula Student

First Formula Student or Formula Society of Automotive Engineers (SAE) was held in 1979 at University of Houston and conceived by Dr. Kurt M. Marshek. Before this, the formula SAE was known as SAE Miny-Indy (Formula SAE, 2007). Miny-Indy means the car was small compared to the Formula 1 race car. First car entered this competition was made out of wood and used five horsepower engine. The engineering students who had entered this first Formula SAE competition must designed and build a small race car using the same engine power. For the first formula SAE competition, thirteen universities were entered but only eleven universities had completed this race. University of Texas is the first university has won his race.

On 1980, three students from University of Texas at Austin had proposed a new rules and regulation and also new concept of Mini-Indy. All the engine must used four stroke engines with 25.4 intake restriction (Formula SAE, 2007). Then, Dr. Robert Woods from University of Texas changed the concept of the competition. He wanted students to design and build a race car for limited series production.

Starting from this until now, the Formula SAE has make a lot of changes in term of concept, rules and regulation and also many more. Now, a formula SAE has become more establish and attracts many schools and universities to join this competition.